

CURRENT SCIENCE

Vol. X]

AUGUST 1941

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THE STANDARDISATION OF DRUGS AND CHEMICALS

MEDICINE is closely meshed with the gears of our social and economic organization, and the problem of public health is bound up as much with the skill and efficiency of medical care, as with the purity and strength of the drugs employed by the profession in alleviating human suffering. In 1930 the Government of India appointed the Drugs Enquiry Committee under the chairmanship of Sir Ram Nath Chopra to investigate the question of adulterated and low standard drugs freely offered for sale, and to submit recommendations for combating the menace

to public health, and for controlling the ethical drug trade and the scientific medical practice in India. After a comprehensive examination of the whole problem in all its various aspects, the Committee emphasised the need for the enactment of a measure by the Central Legislature for the control of the importation, manufacture, sale and distribution of adulterated and substandard drugs, and secondly for the establishment of a machinery for the systematic collection and testing of drugs to secure conformity to proper standards of purity and strength. On the basis of these recommendations The

Indian Drugs Act was passed in 1940, and the nucleus of a Central Laboratory (which later was developed into Bio-chemical Standardisation Laboratory) was founded in 1937 as an adjunct to the All-India Institute of Hygiene and Public Health in Calcutta. The Laboratory which has grown from small beginnings, is now fairly satisfactorily equipped for research work of a high character in the science and art of preparing drugs, and is provided with a Bio-assay Section for acute and many chronic experiments in connection with hormones and vitamins.

Perhaps the most interesting section of the Laboratory is the Drug Museum, which is to function as a reference centre, and where various types of pharmaceuticals and biological products which are commonly found adulterated, understrength or misbranded in the open market, either as a result of wilful adulteration or subterfuge or as storage deterioration, will be properly displayed.

The triennial report of the Laboratory just issued is an impressive document, recording achievements during the period of 1937-40 whose significance will be of the highest importance, not only as a measure of fulfilment of the chief functions outlined by the Central Drugs Laboratory, but also as a means for a better organisation of public health work. In the initial stages, the work of the Laboratory was mainly confined to routine analytical work of certain definite drugs of comparatively greater importance, and attention was accordingly concentrated on surveying the quality of Tincture Digitalis, Tincture Strophanthus, Tincture Scilla, Posterior Pituitary Extract, and Adrenaline Hydro-

chloride Solution, including among these a few samples of insulin, organic antimony, and arsenic compounds and sulphonamide preparations. This survey has shown that out of a total of 1,044 samples of pharmacopœial preparations, nearly 480 or 46 per cent. do not satisfy the standards laid down. "There cannot therefore be any doubt about the seriousness of the situation regarding the drug adulteration existing in this country." Analysis of other pharmacopœial drugs, those mentioned in the British Pharmaceutical Codex 1934, patent, proprietary and miscellaneous remedies and Hospital mixtures and solutions revealed that a very large percentage fell below the specifications claimed by the manufacturers and dispensing agents. Though the results of investigation may bring to light the poor quality of medicines ordinarily supplied to the people, yet they prove that the constitution of the patients is of the appropriate standard. Perhaps a more alarming picture would have been presented, if proper arrangements had been made for the checking of imports, policing of manufacturing houses and frequently inspecting the retail dealers' stores. With the enforcement of the Drugs Act, perhaps a more wide-spread and constant vigilance is now possible.

The Laboratory has a very comprehensive routine work, the functions including the assaying and testing of chemicals, drugs, biological products and organometallic compounds, standardisation of methods of analysis and tests with due regard to the climatic and other conditions prevailing in different parts of India, in addition to undertaking tests of commercial drugs for manufacturers and dealers, preparation and maintenance of stable standards of strength,

purity and quality of drugs. The Laboratory acts as a "National" distributing centre for International standards, aside from acting as an expert referee in respect of disputed analysis. Important as this work must be in guaranteeing the appropriate specifications of important remedies for general use, the Laboratory influence as a scientific centre will be exerted in the field of researches on pharmacological testing of drugs, in guiding and co-ordinating the work of the Provincial Government laboratories, and in serving as the training ground for "public analysts" in the methods of chemical, biochemical and biological assay. With the object of warning non-ethical and fraudulent manufacturers and distributors in India, and also with the object of creating a consciousness amongst the consuming public of the importance of the problem of drug adulteration from the public health point of view, the Laboratory has carried out propaganda by the publication of informative articles and through press circulars.

The excellent and far-reaching results obtained by the Laboratory must find a wider application than merely an appreciation of the quality of drugs, for the imposing array of facts and enlightening figures must have a deeper significance in relation to a better organization of medical care. The needs of a vast population of a country like India cannot be estimated by doctors alone; the problem is to be investigated by social scientists, economists and government administrators. What emerges as a result of scientific comparative study of all the

possibilities of improvement should form the basis of a comprehensive policy of reorganization of public health administration. We have hardly an adequate conception of what constitutes a proper medical care and insurance of public health, for the problem transcends the scope of medical relief. We have to deal not only with the medical and scientific problems relating to drugs, but also, with the social and economic problems as well, and unless these two aspects of the insides of family situations and of homes are thoroughly understood, the efforts of laboratory standardisation of drugs alone can afford but a partial alleviation.

It is impossible to read the Report profitably unless it is borne in mind that the aims and purposes of the Laboratory traverse beyond the strictly scientific or professional angle, and we are convinced that the intent of the manifold investigations is to prove in order to improve human existence. We are poignantly aware that the human problem is of subtle composition, capable of being solved not by laboratory experiments only but by investigations guided by all the resources of science and statesmanship. Of outstanding interest to us in the whole report is the fact that medical scientists will find in the results of investigations conducted in the Laboratory, new fields for organizing medical care and for planning for the health of the population and for the formulation of proposals for advancing medical science, raising standards of medical practice and for improving medical education.

LADY TATA MEMORIAL TRUST

IN 1932 the late Sir Dorab J. Tata created a Trust to perpetuate the memory of the late Lady Tata and set apart a sum of Rs. 25,00,000 from whose income four-fifths was earmarked for promoting investigation of blood diseases with special reference to leukaemia to which the late Lady Tata fell a victim in 1931. This amount was to be devoted for international awards made by a Scientific Advisory Committee operating in London. The remainder one-fifth was reserved for the benefit of the Indian workers engaged in investigations of problems connected with the relief of human suffering caused by diseases. The value of each international scholarship was fixed at £400 per annum, and the corresponding emolument for the Indian scholars was Rs. 150 per month.

During the eight years in which the endowment has been operating, about 50 scholarships were awarded, and, including renewals, about 28 scholars have been working at different scientific institutions. Roughly India has benefited to the extent of Rs. 78,000 and has produced about 148 papers. This gives an average of 18.5 papers per year and 5.2 per scholar. It has cost the Trust about Rs. 527, an amount equivalent to scholarships for 3½ months to enable an Indian scholar to produce a paper. Virtually this amount represents the scholarship drawn each month by an international beneficiary. We have no idea of the amount expended towards maintaining the international scholars, the institutions where investigations have been conducted and the total output of papers.

The endowment is a magnificent one. India is deeply indebted to the Tata family for the creation of numerous trusts for the benefit of her young men, who, after a brilliant career in the universities, seek for opportunities to prosecute post-graduate work. With the limited funds at the disposal of the universities, they manage to maintain a certain number of scholars in their departments, and as the Lady Tata Memorial Trust has recently reduced the number of admissions, the overflow from the universities now runs into waste. The asset of a country is measured by its output of work, and where young men's energy is diverted into unproductive professions, which might offer the most glittering prizes of life, without being utilized for the enrichment of the people, the country must remain backward and poor. The material resources of India are proverbially rich, and it is the hand of science that can gather the harvest. If under any circumstances science is permitted to be neglected and starved, the country will take a long time to recover from the consequences of such an unwise and imprudent policy. The universities and the existing scientific institutions have to be expanded and provided with adequate funds, and science, as a career for young men of promise, should be made to offer them sufficient attraction. Among the post-war problems which will soon confront the statesmen of India, none will be more serious and urgent than the problem of young men, able and willing to do work but finding none. Science and industries may offer a solution.

THE WHEAT RUST PROBLEM OF INDIA

BY

K. C. MEHTA

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INDIA is one of the prominent wheat-growing countries of the world and the largest producer of that commodity in the British Empire yet, with the exception of a temporary revival at present, she has been steadily losing her position in the international market. Considering the fact that on an average there are 34 million acres under wheat each year, a yield of less than 10 million tons is exceedingly poor. This is largely due to the fact that nearly 80 per cent. of the area is covered by the inferior quality, indigenous (*dé'si*) varieties. Inadequate manuring, absence of irrigation and the frequent failure of winter rains over large tracts are the other obvious causes of poor yield. In addition, rusts are responsible, year after year, for a colossal damage to the wheat crop.

In view of the rapid increase in the population of this country, as revealed by the recent census, there is danger of a serious shortage in the supply of wheat even for home consumption in the near future. It is necessary, therefore, to stress the need of a fuller understanding of the problem under review so that efforts be made, at an early date, to obtain a much higher yield from the same area by mitigating, as much as possible, the huge loss that is caused by rusts at present.

Unfortunately, in the greater part of the wheat area, all the three rusts, black, brown and yellow, are fairly common. Yellow and black rusts also attack barley, which covers an acreage of 8-9 millions per year in this country.

Rusts of wheat are caused by three different species of a parasitic fungus belonging to the genus *Puccinia*. Each rust spreads from plant to plant by microscopic germs (spores) that are blown by wind. Under favourable conditions of weather, a single spore may give rise, within 7-10 days from the time it alights on a wheat plant, to several blisters (pustules) containing hundreds of fresh spores. That explains how, from an handful of diseased plants in a field, a serious epidemic might be caused within 4-6 weeks, if conditions of weather happen to be favourable for the spread of rust.

For a review of contemporary work

carried out in North America, Europe, Australia and elsewhere as well as for fuller information on different aspects of the wheat rust problem of this country, reference may kindly be made to the various contributions by the writer.¹⁻⁶ In the present article, for want of space, only a brief summary of the more important results is given.

SOURCES OF ANNUAL RECURRENCE

Butler⁸ stated that *Berberis*, the well-known alternate host of black rust in temperate countries, may be left out of account in India. Butler and Hayman¹⁰ found that after five minutes' exposure at 45° C. or on exposure to the sun for a few hours when the shade temperature was 95° F., uredospores (the winter stage) of yellow rust lost all viability. These authors concluded that in the plains of India infection from the previous crop was extremely unlikely. Burns (1909, work unpublished) concluded, from inoculation experiments carried out under the shade of a mango tree during May at Poona (1850 ft. a.s.l.), that given a series of wheat plants, two or almost three generations should secure the continuance of black rust from season to season in the uredo-stage. Later, Butler⁹ stated that teleutospores (the summer stage in this country) of black rust have lost their power of germination in the plains and that it is doubtful if the barberries carry the race of the parasite, which is found on wheat, even in the hills. He concluded that no satisfactory answer could be given to the question as to how rusts tide over the unfavourable season when they have no wheat to feed on.

That raised the fundamental question as to where lies the source? The present state of our knowledge regarding the fresh infection of wheat by each of the three rusts, from year to year, is summarized below:—

(1) Fortunately, *Berberis vulgaris* Linn. and *Thalictrum flavum*, the two most susceptible species of alternate hosts of black and brown rusts respectively, do not occur in India and so far no alternate host

has been discovered anywhere for yellow rust.

Germination of teleutospores of black and brown rusts was obtained, in this country for the first time, during the course of recent studies and a large number of inoculations were made on their alternate hosts.

(2) *B. lycium* and only seedlings of two other indigenous species have been found to be moderately susceptible to black rust. Similarly, two indigenous species of *Thalictrum* have shown moderate susceptibility to brown but there is no case on record, nor could any evidence be obtained during recent studies, of an outbreak of either of these rusts starting from its infected host in nature. In India, barberries and *Thalictrum* grow only in the hills.

(3) On the other hand, black and brown rusts have been found to break out, year after year, at several places in the plains as early as December-January, i.e., 3-4 months prior to the period of the earliest possible infection of their alternate hosts in the hills.

(4) Recent studies have clearly shown that the alternate hosts, referred to above, play little part in the annual recurrence of black and brown rusts, at any rate, as far as the plains are concerned.

In view of the scarcity of viable teleutospores even in the greater part of the wheat area in the hills and the general dryness of weather during spring, infection of barberries and *Thalictrum* is more likely at higher altitudes (nearly 7,000-9,000 ft. a.s.l.) during the monsoon, June-August but this should be of little consequence to the crops which are ready for harvest by the end of June practically all over the hills.

(5) On account of the intense heat of summer that follows the harvest, it is almost impossible for uredospores of any of the rusts of wheat to survive in the plains and consequently there is no local source of infection at the time of the next sowing.

(6) Uredospores of all the three rusts, two of which as stated above also attack barley, have however been repeatedly found to overwinter on self-sown plants and ratoon tillers of wheat and barley in the hills because of milder weather. At Simla (nearly 7,000 ft. a.s.l.) all these rusts have been found to overwinter as well as overwinter in miniature plots during the last 10 years.

(7) Several times, fresh outbreaks of

rusts have been observed in the hills after 4-6 weeks of sowing of the new crop, within a few feet of rusted stray plants of wheat and there is plenty of uredo-material, at altitudes suitable for each rust, at the time of new sowings. Black rust of wheat has also been found simultaneously on some wild grasses but no evidence could be obtained of its propagation, from season to season, on any of them.

(8) Well-advanced infection of early crops in some of the hills has also been found long before rust outbreaks in the neighbouring plains. In general, rusts have been observed to appear much earlier and plant for plant there is heavier infection at foot-hills than at places farther off in the plains.

(9) Wheat sown 'out of season', at some of the foot-hill stations at writer's request, got infected as early as September-October, 2-4 weeks before the normal period of sowings in the neighbouring plains.

It is clear that all the three rusts of wheat are largely propagated by uredospores in the hills, from season to season. The rôle of uredospores in the annual recurrence of rusts, therefore, is a factor of outstanding importance and far more potent than that of alternate hosts.

DISSEMINATION IN RELATION TO INITIAL OUTBREAKS

In the plains of India, initial outbreaks of rusts are delayed by 2-3, sometimes 3-4 months from the time of sowings, whereas wheat inoculated several times, with uredo-material of black and brown rusts brought down from the hills during October-November, in a cage at Agra, which is one of the warmer places, got infected in 7-8 days. In the case of yellow rust, which thrives in cool weather, infection took place only towards the end of November. That should leave little doubt regarding the suitability of weather from the start for black and brown rusts and in the case of yellow from the end of November onwards, yet normally none of these rusts breaks out at Agra before the middle of February. It is conclusive, therefore, that there is no local source of infection in the plains at the time of sowing and that rusts are re-introduced therein, year after year, from some other source. Consequently, rust outbreaks in the plains can only be caused as a result of dissemination of the inoculum from the

hills by the most obvious agency, i.e., the wind.

A comprehensive study of Rust Dissemination was, therefore, started in the year 1932. During the course of this work, arrangements were made for catching rust spores on slides in aeroscopes at 62 representative stations. Spores were also caught at Agra with the help of mechanical traps, kites, and balloons. A few slides were exposed from aeroplanes also at Delhi. Besides the examination of a huge number of slides, 11,355 wind-trajectories were prepared and scrutinized in connection with the initial outbreaks of each of the three rusts, under review, at 20 representative stations. The writer is unable to supply much information on this subject because his second monograph giving details of Rust Dissemination has not yet been published. However, results obtained from work already published are summarised below:—

(1) Uredospores of each of the three rusts were caught from the air, well before its appearance on the local crop at a large number of stations.

(2) The similarity between the physiologic-race flora (the different strains of each rust) of hills and the plains is another proof, and a strong one too, of the fact that the source of all the three rusts, under reference, lies in the hills.

(3) In all probability, black and brown rusts are disseminated from comparatively low altitudes where, on account of milder winter, their uredospores occurring at the time of sowing cause infection on the new crop rather early in the season. In the case of yellow rust, the inoculum must be blown down originally from higher altitudes because, normally, it is unable to survive during summer below 6,000–7,000 ft. a.s.l.

(4) Two important foci where, due to early crops, there is plenty of inoculum, year after year, at the time of sowings in the plains, have been located. These are central Nepal in the north and Nilgiris and Palni hills, taken together, in the south. In addition, hills with altitudes of 6,000 ft. and above are potential foci of all the three rusts. Black and brown rusts may also be disseminated, at least occasionally, from altitudes of nearly 4,000 ft. and above.

PHYSIOLOGIC RACES

Just as there are different varieties of wheat, each of the three rusts, under refer-

ence, has different strains, better known as Physiologic Races. The occurrence of Physiologic Races within the 'Specialized Form', *Puccinia graminis tritici*, the black rust of wheat, was first recorded by Professor E. C. Stakman of Minnesota, U.S.A.

As elsewhere, this study has been carried out on the lines standardized by Stakman and Levine. The work was started in the year 1932 and the Physiologic Races met with till March 1938 are mentioned below:

(1) Black rust of wheat.—Out of 144 races reported from different parts of the world, only six were found from a study of 586 collections obtained from plains as well as the hills. These are Nos. 15, 21, 24, 40, 42 and 75 of the International list. Races, 15, 40, 42 and 75 were also found on barley from the study of 33 collections. Seven collections from three wild grasses yielded races 15, 40 and 42 of this rust.

(2) Brown rust of wheat.—In 408 collections from different parts of the country, only six races were found. These are Nos. 10, 20, 63, 106, 107 and 108, the last four are new and had not been found anywhere else till the year 1939, when the last International list of 108 races was issued by Humphrey, Johnstone and Caldwell, U.S.A.

(3) Yellow rust.—A study of 236 collections yielded Nos. 10, 19, 20 and 31 out of a list of 38. Besides, four new races that have provisionally been labelled as A, D, E and F were found. These had not been reported from any other country till 1937. Race 19 of this rust was also found in five collections of barley.

The occurrence of a small number of physiologic races in India makes the breeding of resistant varieties more hopeful than is the case in some other countries. During the course of these studies, work in connection with the breeding of rust resistant wheats, for cultivation in the hills, was also started in the year 1935, in collaboration with the Imperial Economic Botanist. Recently, a very promising wheat from Kenya was found to be highly resistant to the most virulent race 15 as well as 40 of black rust, Mehta and Pal.⁷ This discovery has greatly simplified the breeding of a wheat resistant to black rust.

CONTROL OF EPIDEMICS BY DIRECT MEANS

Rusts are known to cause huge damage in every country where wheat and barley are extensively grown. No reliable figures are available in this country regarding the

actual loss but considering the acreage of 43 millions under the two crops, taken together, it may amount to 60 million rupees a year. Even this figure might be an underestimate, based as it is on a loss of only 6 per cent. of the value of the entire yield.

Now that the problem under review has been largely solved and we know definitely the sources of initial infection, wherefrom rusts are disseminated year after year, it is time efforts were made to control them. It is obvious that the survival of rusts from season to season only in the hills, which occupy less than 5 per cent. of the entire area under wheat and barley in this country, offers a unique opportunity of control by relatively simple and inexpensive means. The writer's opinion on the practicability of the various methods of combating rusts, with special reference to the conditions in India, is briefly discussed below:—

(1) In order to eradicate rusts at the source, the writer, Mehta,² suggested that cultivation of wheat and barley should be suspended in the hills for 2–3 years. This method would be effective only with the co-operation of neighbouring States that own a considerable part of the hilly area.

(2) Dusting the wheat crop with sulphur powder from aeroplanes, which has been attempted on a small scale in some parts of North America, would be impracticable in this country because nearly 80 per cent. of the area is covered by the highly susceptible, indigenous (*dési*) varieties. This method would involve huge expense over weekly applications of sulphur and cost of aeroplanes, etc. Besides, on account of prevailing dry weather during the period of growth of wheat in the plains, most of the sulphur is likely to be blown off the surface of plants, from time to time.

(3) The other method of control, which is universally recognized, is to cultivate resistant varieties. For the reasons given above, in this country it would suffice to grow resistant varieties of wheat and barley only in the hills, wherefrom rusts are re-introduced into the plains, from year to year. As stated above, breeding of rust resistant wheats is in progress and it is hoped that similar work on barley will soon be started. In view of the prevalence of all the three rusts in most of the hills the task of breeding a wheat, which would resist them all, is likely to take several years and for an

effective control at the source we need also a variety of barley resistant to black and yellow rusts.

(4) 'Clean-up', i.e., rigorous destruction of 'out of season' wheat and barley (self-sown plants, tillers and stubble), which carry over the rusts, 1–2 months before sowing in all the hills and hilly tracts should be an effective method of control in India in view of the small holdings.

(5) Considering the small acreage under early crops in the Nilgiris, Palni hills and central Nepal, suspension of the first crop, sown during April–June in the first two areas and postponement of sowings in the last to the normal period, i.e., October, should be the most effective methods of direct control of rust epidemics in the greater part of Peninsular India and the Indo-Gangetic plains, respectively.

In connection with No. (3), it is essential to refer to an important recent observation by Professor Stakman of U.S.A., a leading authority on cereal rusts, stating that rust resistance in varieties so far known is a variable character like any other plant character. Further, that even so resistant a variety of wheat as Hope may rust quite normally when light intensity is reduced and that under cloudy conditions, therefore, when there is considerable moisture, it may be heavily rusted if large numbers of spores are present in the air.

The above conditions of weather are of frequent occurrence in the hills of India and there is a considerable amount of inoculum always present in those parts. It would be wise, therefore, to enforce 'Clean-up' in the hills at an early date and not put it off till resistant varieties are available, when this method will have to be adopted for the success of control by their cultivation. Notwithstanding the difficulties of supervision of 'Clean-up' in the hilly areas and a certain amount of expense to Provincial Governments and the States concerned for such arrangements, the writer is fully convinced that this method is worth attempting and if carried out rigorously should mitigate considerably the huge loss that is caused by rusts, from year to year.

In conclusion, it may be stated that the direct methods of control described under (4) and (5) are practicable and ought to be tried without delay. In the earlier stages of their adoption, rusts may appear here and there but should not break out early

enough to cause devastating epidemics over large tracts of the country, as at present. That should lead to a saving of millions of rupees annually whereas the cost over these measures would amount only to a few thousands.

These methods have been approved for trial by competent bodies of the Imperial Council of Agricultural Research as well as by some of the leading scientists abroad and it now remains for Provincial Governments and the States concerned to test their efficacy over a number of years *simultaneously* in their respective territories.

ACKNOWLEDGMENTS

The writer wishes to express his warmest thanks to the Imperial Council of Agricultural Research for various grants sanctioned for the continuance of investigations on cereal rusts, with the help of temporary

research staff, since the year 1930, prior to which this work was carried out by the writer for a period of seven years at considerable personal expense.

Other acknowledgments due have been fully recorded in the two monographs, referred to above, and for want of space it is unnecessary to repeat them here.

¹ Mehta, K. C., *Proc. 12th Ind. Sci. Cong.*, 1925, 191.

² —, *Proc. 16th Ind. Sci. Cong.*, 1929, 5, 199.

³ —, *Ind. J. Agric. Sci.*, 1931, 1, 297.

⁴ —, *Ibid.*, 1931, 1, 302.

⁵ —, *Ibid.*, 1933, 3, 939.

⁶ —, *Sci. Mon. Imp. Comm. Agric. Res. Ind.*, 1940, 14.

⁷ —, and Pal, B. P., *Nature*, 1940, 146, 98.

⁸ Butler, E. J., *Dept. Agric. Ind. Bull.*, 1903, 1.

⁹ —, *Fungi and Disease in Plants*, Calcutta, 1918.

¹⁰ —, and Hayman, J. M., *Mem. Dept. Agric. Ind. Bot.*, 1906, 2.

OBITUARY

DR. W. L. DAVIES, Ph.D. (Cantab.), D.Sc. (Wales), F.I.C., N.D.A.

IN the sudden death in Delhi of Dr. W. L. Davies, at the early age of 45, the cause of scientific research in milk and milk products has suffered a grievous loss.

After a distinguished career at the Reading University where he was Advisory Agricultural Chemist to the Southern Advisory Province from 1924 to 1927 and Research Dairy Chemist to the National Institute for Research in Dairying, Shinfield, from 1927 to 1939, Dr. Davies arrived in India to take up the duties of the newly created post of Director of Dairy Research under the Government of India. He applied at once with characteristic enthusiasm to the establishment of an Imperial Dairy Research Institute in New Delhi, but the war unfortunately interfered with the immediate financing of an ambitious project. Undaunted, Dr. Davies approached the Imperial Agricultural Research Institute for such laboratory facilities as can be spared, and, on these being readily offered, he initiated research work on urgent problems of the dairy industry, particularly detection of adulterants in *ghee*. The considerable knowledge which he acquired in the course of a preliminary survey of the indigenous

industry he embodied in a brochure entitled "Indian Indigenous Milk Products". The standard of this book is such as to be useful to all interested in the exploitation of milk in India, especially students of dairying, agricultural and animal husbandry, biochemists, analysts and technologists. The other contributions while in India include articles on (a) Colloid aspects of milk technology, (b) Deterioration of butter during storage, (c) Conservation of grass, and (d) Anti-oxygenic effect of cereal flour paste as a coating on contact wrappers for fatty foods. Dr. Davies' great reputation as a Dairy Chemist will, however, continue to be enshrined in his Monograph on "The Chemistry of Milk" (being Volume 10 of a series of monographs on Applied Chemistry under the Editorship of Dr. Howard Tripp; Chapman & Hall) which was so well received by the scientific world that a second edition was called for within three years of its original publication in 1936.

During the 22 months he was spared to live in India, Dr. Davies made many contacts, and impressed all as a good "mixer" and a devoted scientific worker.

B. V. N.

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ISOTOPE EFFECT IN THE (OH), (OD) BANDS

As was pointed out recently by the author,¹ OH and OD form an interesting pair of isotopic molecules, the band structure of which yields valuable information on the isotope effect in band spectra. The ordinary theory enables the calculation of the vibrational and rotational effects to a first approximation by well-known formulæ² in terms of ρ , the mass factor. From the available values of the constants of the OH molecule,³ the isotopic shifts corresponding to the band heads have been calculated on the above simple theory and presented in the table below. The experimentally observed values, which are directly obtained from measurements on our plates of the spectra of the OH and OD bands are also shown. The disagreement between the observed and the calculated values is genuine and obvious.

Johnston and Dawson⁴ (referring to three of these bands) indicated that this difference can be explained as due to the effect of spin coupling. In H^1H^1 and H^1H^2 band systems⁵

v', v''	Calculated isotopic shift			Observed shift
	Vibra-tional	Rota-tional	Total	
0,1	1016.9	-138.3	878.7	860.6
0,0	76.7	-89.8	-13.1	-12.4
1,1	240.3	-76.5	163.8	166.7
2,2	417.7	-63.7	354.0	358.6
1,0	-699.9	-57.1	-757.0	-749.3
2,1	-449.1	-49.7	-498.8	-483.7
3,2	-184.5	-42.8	-227.3	-200.1
2,0	-1389.4	-40.8	-1430.2	-1414.8
3,1	-1051.3	-36.0	-1087.3	-1061.8
3,0	-1991.5	-31.1	-2022.6	-1994.5

a large electronic isotope shift (as high as 136 cms.⁻¹) was observed by Jeppesen. Correction terms⁶ arising from the influence of the interaction between the electronic motion and the rotation and vibration are also to be taken

into account in estimating the shifts accurately. A discussion of these applied to the band head shifts and the shifts in the rotational structure of the individual bands will be presented in detail elsewhere.

M. G. SASTRY.

Andhra University,
Waltair,
June 30, 1941.

¹ *Ind. Jour. Phys.* (in press).

² Jevons, *Report*, p. 209.

³ Tanaka and Koana, *Proc. Phys. Math. Soc. (Japan)*, 1934, **16**, 365.

⁴ *Rev. Mod. Phys.*, 1935, **7**, 83.

⁵ Jeppesen, *Phys. Rev.*, 1934, **45**, 480.

⁶ Van Vleck, *Jour. Chem. Phys.*, 1936, **4**, 327.

MAGNETIC SUSCEPTIBILITY OF STRONTIUM

THE thermomagnetic properties of some sixty elements were measured in a comprehensive manner by Honda¹ and Owen.² The specific magnetic susceptibility of strontium was found to be -0.20 .³ The observed values of the susceptibility of this element were, however, all positive. Stoner⁴ suggested the possibility of an overcorrection for the relatively large iron content. In view of the present uncertainty of the susceptibility of strontium, a careful thermomagnetic investigation of this element was undertaken.

A pure Merck specimen of the metal was available. A spectroscopic examination showed traces of calcium and lead. The Curie method was adopted, taking small quantities of the fused metal in light pyrex glass bulbs. The susceptibilities were determined at field strengths between 3 and 8 kilogauss. The variation of the specific susceptibility with field strength showed traces of ferromagnetic impurities. The susceptibility at infinite field strength was determined from the $\chi, \frac{1}{H}$ graph. The mean specific susceptibility of strontium calculated from observations made on eight samples, was found to be $+1.05$. The element was thus found to be paramagnetic.

The gram atomic susceptibility of the metal is therefore $+92.0$. Kido's⁵ value for the ionic susceptibility of Sr^{+2} is -15.6 . This shows that the two valence electrons of the strontium atom have a susceptibility of $+107.6$ (per gram atom of the metal). The width of the occupied energy range in the completely degenerate state of the valence electrons works to about 0.6 volt. Our result supports Stoner's⁴ observation that in the alkaline earth elements, the electron energy bands are much narrower than for free electrons.

Experiments on the temperature variation of the paramagnetic susceptibility of strontium are in progress. A detailed account will be given elsewhere.

S. RAMACHANDRA RAO.
K. SAVITHRI.

Annamalai University,
Annamalainagar,
August 2, 1941.

¹ *Ann. der Phys.*, 1910, **32**, 1027.

² *Ibid.*, 1912, **37**, 657.

³ All susceptibility values are given in 10^{-6} unit.

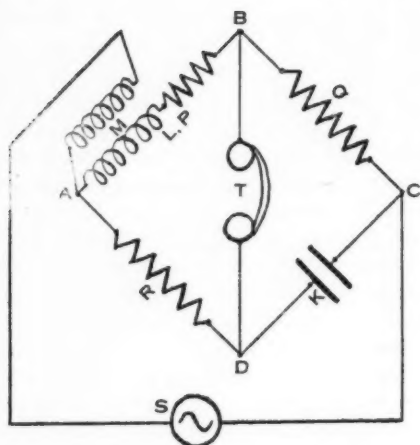
⁴ *Magnetism and Matter*, 1934, p. 512.

⁵ *Sci. Rep. Tohoku Imp. Univ.*, 1933, **22**, 835.

A BRIDGE METHOD FOR DETERMINING THE FREQUENCY OF AN ALTERNATING CURRENT IN THE AUDIO-FREQUENCY RANGE

THE various bridge methods for measuring the frequency of alternating current, so far suggested and employed, have been classified by Hague¹ with reference to their adjustment characteristics and their arm elements. The new bridge whose circuit diagram is shown below has an adjustment characteristic of the form $f = a\sqrt{x}$, which is a parabola.

The branch AB of the bridge contains the primary coil of the mutual inductor M; its self-inductance is L; in series with it an adjustable non-inductive resistance box is connected; P denotes the total resistance, including that of the coil, in the branch AB.



The arms BC and AD contain adjustable non-inductive resistance boxes only; K is a good mica condenser in the branch DC; one end of the secondary coil of the mutual inductor M is connected to that of the primary at A and the other end is connected to the source S of the alternating current whose frequency has to be estimated; T is a telephone used as a detector of the balanced state.

Applying Kirchhoff's rules to the meshes of the impedance network carrying harmonic alternating current and simplifying the equations thus obtained, we get for zero current in the telephone the following two conditions:—

$$(1) \frac{L+M}{K} = QR;$$

$$\text{and } (2) \omega^2 = \frac{P}{KMQ},$$

where $\omega = 2\pi \times \text{frequency}$.

These conditions of balance can be secured without mutual interference by making R the variable in (1), and P the variable in (2). The practical procedure is as follows: L, M, K and Q being fixed, balance, i.e., silence in telephone is attained by successive adjustment of R and P. The process is easy and rapidly convergent since the two conditions of balance are mutually independent. When the proper values of P and R have thus been fixed up for any frequency, the first condition which is independent of frequency remains satisfied for

all frequencies and the bridge may now be employed for determining various frequencies by altering P alone, so that virtually a single adjustment is all that is needed in order to measure the frequencies.

The formula representing the frequency f may be written

$f = a\sqrt{P}$, where $a = (2\pi\sqrt{KMQ})^{-1} = \text{a constant}$. The details of the theory of this frequency bridge and measurements with it will be published elsewhere.

L. M. CHATTERJEE.

Physics Department,
Science College,
Patna,
June 20, 1941.

¹ B. Hague, *Alternating Current Bridge Methods* (Pitman, 1938) p. 515.

CHROMOSOME NUMBER OF *SESAMUM RADIATUM*, SCHUM AND THONN. BESKR.

In connection with breeding work on *Sesamum indicum*, L. various types and certain other species of *Sesamum* have been collected in this Section. Seeds of *Sesamum radiatum* which occurs in a wild state in tropical Africa were obtained from Yandev, Makurdi in Nigeria in 1933 through the kind courtesy of the Superintendent of Agriculture, Nigeria. Since then, this species has been grown with fair success at Coimbatore and at the Agricultural Research Station, Tindivanam. The chromosome number of this species has been determined to be $2n = 64$ (Fig. 1), the technique employed being

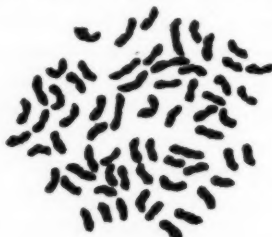


FIG. 1

$\times 3500$.

fixation of root tips in Lewitsky's fluid to which a pinch of maltose was added and staining of sections cut at 12μ by Feulgen's reaction. It is interesting to observe in this connection that the chromosome number of *Sesamum indicum* is $n = 13$ and $2n = 26$ (Nohara, 1934).

C. M. JOHN.
U. NARASINGA RAO.

Oil Seeds Section,
Agricultural Research Institute,
Lawley Road P.O., Coimbatore,
July 17, 1941.

¹ Sigaroku Nohara, *Jour. Coll. Agri. Tokyo Imp. Uni.*, 1934, 13, 9.

RIND HARDNESS AS A POSSIBLE FACTOR IN RESISTANCE OF SUGARCANE VARIETIES TO THE STEM BORER

THAT sugarcane varieties differ from one another in their relative resistance to stem borers is a matter of common observation. This has been attributed to differences between varieties in certain characters, such as, rind hardness, fibre and sugar contents and the habit of the variety. Sugarcane breeders are naturally interested in any such correlation as it might place in their hands a means for breeding-resistant types.

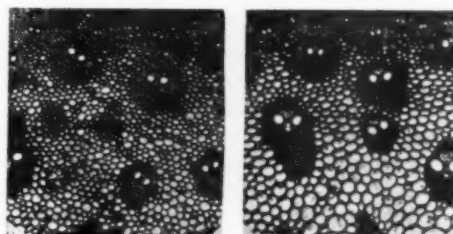
It has recently been possible to measure the relative rind hardness of cane varieties by instruments developed both at Pusa and at Coimbatore. Studies have shown that a fair positive correlation exists between the rind hardness of a cane and its resistance to the stem borer, *Diatrea venosata*, as seen from the table below.

Anatomical investigations were undertaken to study the possible factors that contribute to rind hardness in the sugarcane. It has been found that the three major factors are (1) the number of vascular bundles per unit area, (2) the lignification of cell walls of bundle sheaths and (3) the lignification of parenchymatous cells in the rind region. In any particular variety one or more of the above factors

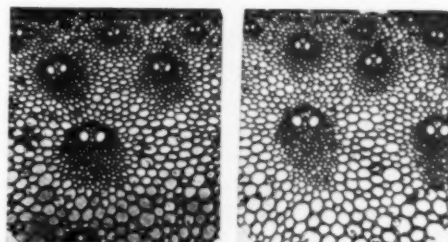
Variety	Rind hardness value in lbs.	Percentage of infestation
Co. 421	17.26	29
„ 331	16.77	39
„ 313	16.46	42
„ 281	15.24	39
„ 213	14.99	31
„ 290	10.88	52
„ 419	8.40	59
Vellai	7.50	62
Poovan	7.31	69

may contribute to its rind hardness. By studying the above three characters, it has been possible to indicate roughly the resistance of particular canes to the stem borer. A general positive correlation has also been found between the fibre contents of a cane and its rind hardness.

Rind Hardness Studies



Co. 385 Co. 421
Canes resistant to stem borer



Vellai Poovan
Canes susceptible to stem borer

Indications are available that the anatomical characters mentioned above are inherited in the sugarcane and it might, therefore, be possible to breed resistant canes by a careful choice of the parents for hybridization.

J. THULJARAM RAO.

Imperial Sugarcane Station,
Coimbatore,
July 14, 1941.

¹ Buzacott, J. H., *Proc. Eighth Ann. Conf. Q'ld. Soc. Sug. Tech.*, 1937, 8.

² —, *Tech. Com. Sug. Expt. Stn., Q'ld.*, 1940, 8.

³ Holloway, H. T., *Sug. Bul., New Orleans*, 1935, 11, 3.

⁴ Khanna, K. L., *Ind. Jour. Agri. Sci.*, 1939, 1, 1.

⁵ Pemberton, C. E., *Rep. Comm. Exp. Stn. H.S.P.A.*, 1934, 1.

⁶ Ueno, T., *Rept. Govt. Sug. Expt. Stn., Formosa*, 1938, 5, 21.

⁷ Venkataraman, T. S., *Proc. Int. Soc. Sug. Tech.*, 1929, 429.

A PRELIMINARY NOTE ON A MELAMPSORA PARASITIC ON LOBELIA TRIGONA ROXB.

THE genus *Melampsora* was founded by Castagne in 1843 to accommodate those rusts whose uredia are characterised by the presence of paraphyses and whose teliospores are combined into compact crusts beneath the epidermis or the cuticle. Over 90 species have so far been described of which ten species are reported to occur in India by Butler and Bisby (1931). Some species belonging to this genus cause serious diseases of crop plants, *Melampsora lini* (Pers.) Lev. for example causing much damage to linseed, *Linum usitatissimum* L. in India.

In December 1940, the writer collected near marshy places in Bangalore, a *Melampsora* on *Lobelia trigona* Roxb. which is new to science. A survey of literature indicated, that no species of *Melampsora* has been described on any members of the family *Lobeliaceae*. The writer proposes to call the rust *Melampsora Mundkuri* Spec. nov. Thirumalachar.

The rust attacks the leaves and twigs of the host, forming yellow concentric patches. Aecia are of the *caeoma* type, characteristic of the genus, and are without any paraphyses. The aecial initials are hypodermal, and the basal cell abstricts off chains of aeciospores, which after rupturing the epidermis are thrown out in large numbers (Fig. 1). The aeciospores are



FIG. 1

Camera lucida drawing of an aecium. $\times 600$.

round or oval in shape, binucleate and measure $15 \times 8 \mu$.

Telia appear as waxy orange coloured crusts when fresh, and are distributed on either surfaces of the leaves, and on twigs. They are not erumpent, but occur as sub-epidermal crusts. The telial initials composed of binucleate cells are hypodermal in origin. Mature spores are thick walled and deep brown in colour, with an apical germ pore. Following nuclear fusion, they become syncaryons. The epidermis and the cuticle above the telia are ruptured and thrown out as crusts. Teliospores measure $25-34 \times 17-20 \mu$ (Fig. 2).

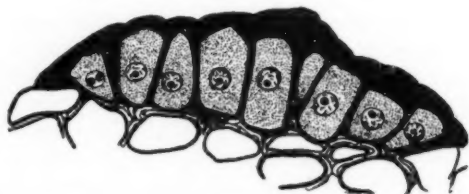


FIG. 2

Teliosorus showing teliospores in a crusty layer. $\times 600$.

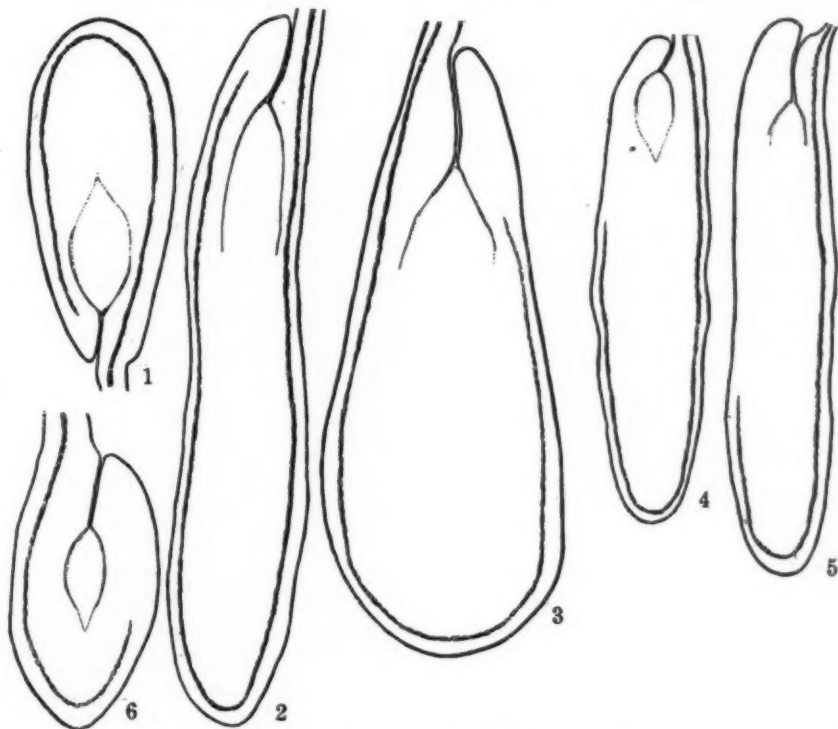
A formal description of the species and a detailed account of the morphology, development of the spore-forms and parasitism will be published elsewhere. The writer wishes to acknowledge his indebtedness to Dr. M. A. Sampathkumaran, M.A., Ph.D., Professor of Botany, Central College, Bangalore, for guidance and encouragement, and to Dr. B. B. Mundkur, Imperial Agricultural Research Institute, New Delhi, for valuable suggestions.

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Central College,
Bangalore,
July 11, 1941.

VASCULAR SUPPLY IN THE OVULES OF SOME COMPOSITÆ

THE ovular vascular supply in Angiosperms generally consists of a single vascular strand which travels up the funicle and ends at the Chalaza. In some plants, however, it is found either to continue its course into the integument on the side away from the funicle or to divide into a few branches which ramify in the chalaza or travel up into the integument. Such deviations have been recorded in various angiospermous plants belonging to families falling in diverse cycles of affinity (cf. Kühn,¹ 1928; Mauritzon,² 1939; Puri,³ 1934; Schnarf,⁴ 1929). In compositæ, the occurrence of integumental vascular traces is previously known in *Helianthus*, *Centaurea*, *Sonchus*, etc., in the



Ovules showing the vascular trace in the integument

Fig. 1, ovule of *Tridax procumbens*; Fig. 2, ovule of *Tagetes patula*; Fig. 3, ovule of *Zinnia elegans*; Fig. 4, ovule of *Emilia sonchifolia*; Fig. 5, ovule of *Eupatorium cannabinum*; Fig. 6, ovule of *Cosmos bipinnata*
Figs. 1 & 4, $\times 39$; Figs. 2 & 3, $\times 31$; Figs. 5 & 6, $\times 54$.

ovules of which the vascular trace is found to travel beyond the chalaza, around the ovule, into the single massive integument on the side away from the funicle, while in *Echinops ritro* and *Liatris elegans* it divides into a number of branches in the Chalaza of the ovule (Schnarf, 1931).⁵ The writer has found, in the ovules of some compositæ, a behaviour of the ovular trace similar to that observed in *Helianthus*, *Centaurea*, *Sonchus*, etc. Entire ovules of *Tridax procumbens*, *Zinnia elegans*, *Tagetes patula*, *Emilia sonchifolia*, *Cosmos bipinnata*, *Eupatorium cannabinum*, *Vernonia cinerea*, *Eclipta erecta*, *Gaillardia picta* and *Launea pinnatifida* have been mounted in aceto-carmin and examined. In the last named four the ovular vascular trace has been found to run through the length of the raphe and end at the chalaza as generally found in the ovules of most Angiosperms, while in the rest the vascular trace is found to travel beyond the chalaza, around the ovule, into the single massive integument. It runs up almost to the proximity of the micropyle in *Tridax procumbens*, *Tagetes patula* and *Zinnia elegans* (Figs. 1-3), upto about half the height of the integument in *Emilia sonchifolia* (Fig. 4) and upto about one-third to less than half in *Cosmos bipinnata* and *Eupatorium cannabinum* (Figs. 5 and 6). The vascular trace is very slender and consists of a few tracheids in its thickness.

J. VENKATESWARLU.

Andhra University,
Waltair,
June 17, 1941.

¹ Kühn, G., *Engler's Bot. Jahrb.*, 1928, 61. (Summary in *Biol. Abstracts*, 1932, 6, entry 25584.)

² Mauritson, J., *Lunds. Universitets Årskrift*, N. E., 1939, Avd. 2, Bd. 35, No. 2.

³ Puri, V., *Proc. Ind. Acad. Sci.*, 1934, Series B., 1, 6.

⁴ Schnarf, K., *Embryologie der Angiospermen*, Berlin, 1929.

⁵ Schnarf, K., *Vergleichende Embryologie der Angiospermen*, Berlin, 1931.

NOTE ON THE INFECTION OF COPEPOD (*DIAPTOMUS*) WITH LARVAL TREMATODE*

WHILE examining some copepods collected from one of the freshwater ponds in Bangalore, Mysore State, India, in connection with certain investigations on dracontiasis, it was observed that a specimen of *Diaptomus* was naturally infected with a larval trematode. It is proposed to present in this paper a brief description of this parasite.

The larva was found sluggishly moving in the body cavity of *Diaptomus*.

Description.—Body oval in shape, 0.251 mm. long, narrow and bluntly pointed at the extremities and wide in the middle; maximum width slightly posterior to the oral sucker, 0.13 mm.; and 0.081 mm. wide in the region of the oral sucker and also in the region slightly posterior to the ventral sucker. Cuticle delicate, slightly thickened at the extremities, traversed by fine cross striations. Oral sucker oval, 0.066 mm. by 0.044 mm. situated 0.021 mm. from the anterior extremity, opening transversely oval, 0.021 mm. by 0.01 mm. Pharynx 0.046 mm. long and 0.028 mm. wide. Ventral sucker circular, with a 0.1 mm. in diameter, with circular opening 0.042 mm. in diameter, situated 0.1 mm. from the anterior extremity. Tail about one and one-fourth the body length (0.31 mm.) and is a continuation of the posterior end of the body.

This trematode appears to belong to the family Hemiuridae.

Diagnosis of female (male not known):

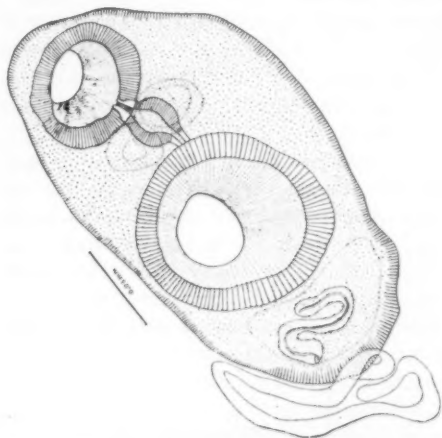
Body compact, convex dorsally, somewhat compressed; total length, excluding caudal setæ, 1.55 mm.; length of cephalothorax 0.5 mm.; length of metasome 1.1 mm.; length of genital

* The writer is greatly indebted to Dr. E. W. Price, Zoological Division, United States Bureau of Animal Industry, for valuable help and guidance given. The description of the *Diaptomus* Sp. given in the appendix was prepared in co-operation with Dr. Olga Hartman, United States National Museum, Washington, D. C., to whom the writer is greatly indebted for the ready help given.

segment 0.5 mm.; length of urosome 0.25 mm. Greatest thickness, at posterior end of cephalothorax, 0.5 mm.

Antennae consisting of 27 distinctly articulated segments; moderately long, extending distally

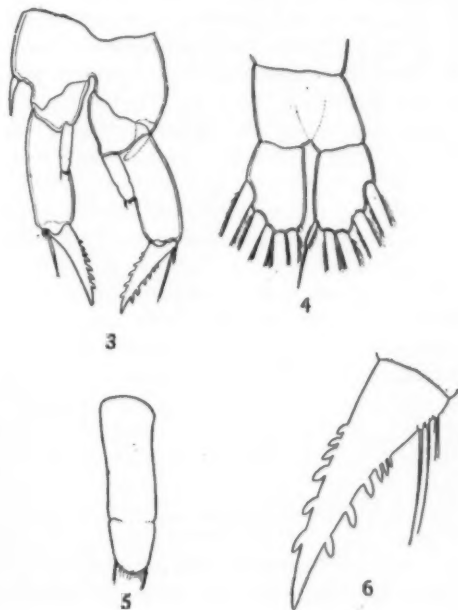
to the anterior end of the caudal rami. Metasome composed of 5 segments including cephalothorax, the latter slightly more than 1/3 of its total length. Post lateral edges of metasome with 2 small spines, one at extreme posterior edge and another slightly anterior and lateral to it. Abdomen of 2 segments, a genital segment which is longer than broad, and a second



FIGS. 1-2. Larval trematode

Fig. 1.—Camera lucida drawing of the larval trematode

Fig. 2.—Photomicrograph of the larval trematode situated in the body cavity of a *Diaptomus*. $\times 100$.



FIGS. 3-6. *Diaptomus* Sp.

Fig. 3.—Fifth feet of female in ventral view. $\times 170$.

Fig. 4.—Caudal rami in dorsal view. $\times 170$.

Fig. 5.—Endopodite of left fifth leg. $\times 525$.

Fig. 6.—Distal spine from left fifth leg. $\times 525$.

segment only 2/7 as long as the first segment. Length of caudal rami about $1\frac{1}{2}$ times their width, each provided at their distal end with 5 stout, plumose setae and a slenderer inner one which is biarticulated (Fig. 4).

Fifth pair of legs as follows:

Left leg longer and stouter than right, its basal segment with a stout, blunt curved spine on the dorsolateral edge (Fig. 3). Endopodite small, greatly outdistanced by exopodite,

indistinctly 2-segmented, the proximal segment about twice as long as wide, the second segment slightly longer than wide, rounded distally, provided with a few longer setae at its ectal margins and more numerous delicate setae at its medial tip (Fig. 3). Exopodite with third segment more than twice as long as broad, its distal spine heavy, about $2/3$ as long as segment 3, provided on each side with 6 stout tubercles which increase in size from proximal to distal end. Two long and several shorter setae are inserted at ectolateral edge of segment 3 (Fig. 6).

Right leg similar to left, but differing as follows: basal spine shorter and slender; distal spine with a single row of 7 stout tubercles increasing in size as in the left leg.

Known from a single specimen infected with a larval trematode.

Type:—In the collection of Friedrich Kiefer, Karlsruhe (Baden) Karlstr. 128 (Germany).

Habitat:—Bangalore, South India.

Place of Collection:—Freshwater pond.

V. N. MOORTHY.

Department of Public Health,
Bangalore,
August 2, 1941.

SULPHUR POSITION IN INDIA

I HAVE read with interest the article entitled "The Sulphur Position in India" by Sir S. S. Bhatnagar, Director, Board of Scientific and Industrial Research, which appeared in a recent number of *Current Science*.¹

It is really gratifying to note that the Board of Scientific and Industrial Research has diverted some attention to the question of recovery of sulphur from coal. Sir S. S. Bhatnagar has referred to the waktung (possibly also known as waktung) coal of upper Assam and has indicated the organic nature of the sulphur compounds in that coal. He has also suggested that sulphur compounds might be extracted by solvent processes or by steam distillation; preliminary work has shown, however, that extraction by solvents is pretty difficult and

I think it is very doubtful if such extraction process can be carried out on a commercial scale and on an economic basis. Moreover, as a result of extraction by some organic solvents (I mention this from my experience), the caking property of coals is very much reduced, thus producing a deleterious effect on the coal residue. Though the sulphur content can thus be reduced to some extent, the residual coal may not be found suitable for manufacturing good coke.

It is fairly well known, that apart from consideration of sulphur content, many of the Upper Assam coals are considered to be of the highest grade metallurgical variety with minimum ash. Such coals with extremely low ash (sometimes as low as 1% or even less) are to be found nowhere else in India. Though by means of the extraction process, using organic solvents, some sulphur compounds may be leached out and recovered, the quality of the residual coal will be affected.

Sir S. S. Bhatnagar suggests, in the paper, that if the sulphur compounds can be removed by a cheap process from the coal, the coal itself will become more useful and a good price could be fetched by working the sulphur compounds. But he has not given any indication as to how such a process could be evolved.

It may be mentioned, in this connection, that a series of experiments with many high sulphur Tertiary coals of India were carried out by me for the quantitative determination of various sulphur forms in them.² In a paper³ communicated to the Indian Science Congress, I have indicated some methods for reducing the sulphur content of the coals of Upper Assam, and for producing high class metallurgical coke with permissible amounts of total sulphur. Blending of non-caking coals with caking ones are expected to solve the problem of unusual high swelling in some caking coals.

It was reported in that paper, that laboratory investigations had shown that a good proportion of sulphur compounds could be eliminated in the form of gases during the time of

carbonisation. These results are of interest to the Coal Industry. Experiments on a semi-industrial scale have to be carried out to see how far the laboratory methods might be successful in actual practice. The treatment of sulphur high coals with sodium chloride, hydrogen or cheap producer-gas in the carbonisation chambers erected for the purpose, is well worth investigation. This work may be taken up by the Board. The gaseous products thus obtained may easily be subjected to Thylox or any other suitable process for the recovery of the sulphur compounds. The coke residue in the chamber ovens will form a suitable product for high class metallurgical operations. In the case of non-caking coals the non-coherent residue in the ovens may be briquetted and used for steam raising purpose or can be blended with high swelling coals to give better results. The non-caking coals may also be profitably employed for blending prior to high temperature carbonisation. It has not been, however, yet possible to find out simple ways and means to reduce the sulphur content of the coals thereby making them suitable for use in lumps on the grates of boilers.

These aspects of the problem will perhaps be of interest to the members of the newly formed Sulphur Committee.

N. N. CHATTERJEE.

Post-Graduate Dept. of Geology,
Presidency College,
Calcutta,
June 11, 1941.

¹ *Curr. Sci.*, 1941, 5, 245.

² *Quart. Jour. Geol. Min. & Met. Soc. of India*, 3, 101; 10, 135; 9, 157; *Proc. Nat. Inst. Sci. Ind.*, 6, 523.

³ *Proc. Ind. Sci. Congress*, Benares, 1941, Part 3, 138.

A MARGOSA TREE WITHOUT THE BITTER PRINCIPLE

I HAVE read with interest the brief note by Mr. Cherian Jacob on "A Margosa Tree without the Bitter Principle," published in the July number of *Current Science*.

On *prima facie* grounds Mr. Jacob's explanation seems sound. But it needs to be followed up. It should not be difficult, without appreciable damage to the trees, to cut out a block of wood deep enough to include portions of both the trees, to section it in order to confirm the presumed grafting of the tissues, and to ascertain the exact nature of the connection.

Assuming that there is an intercommunication between the saps of the two trees, several possibilities suggest themselves. It may be, as Mr. Jacob suggests, that the banyan's sap, passing into the margosa, exercises a neutralising influence on the bitter principle. On the other hand, it is possible that the bitter principle of the margosa diffuses into the banyan and may even render it bitter to the taste. A comparison of this banyan's sap with that of others is therefore indicated.

Natural fusions between plants of widely different affinities are not a rare occurrence. After all, parasitic connections such as that between a *Cuscuta* and its hosts (and it is notorious that these may belong to many different families) are to be counted among such natural fusions. It is probable, too, that grafting of tissues can be effected artificially between plants belonging to distant groups. What is worthy of enquiry is whether we can, by this means, improve the quality of fruits by eliminating undesirable flavours due to resins, latex and other substances.

B. SAHNI.

The University,
Lucknow,
August 4, 1941.

CORRELATION AND TIME SERIES

BY

D. D. KOSAMBI

(Fergusson College, Poona)

IN a recent attempt to examine the significance of reverse marks on Taxilan silver punch-marked coins, 753 square coins found in a pre-Mauryan hoard were tabulated by weight in arrays of 0, 1,, 10 reverse marks. The correlation r between reverse mark and weight was found to be $-.46$. Because the evidence pointed to the reverse marks being regularly placed in time, 3,000 current British Indian rupees were taken from active circulation, and their weights determined as a control measure. Discarding counterfeits, mint-defectives, and the (superseded) rare Victoria rupees, there remained 2,886 specimens in 18 arrays, one for each year from 1903 to 1920. The correlation between date of issue and weight was found to be $.43$, which is compatible with the Taxilan value. The two values would actually be closer if Sheppard's corrections were applied, because the grouping unit for British coins is coarser, $.01$ gm. (though the coins were weighed to $.0001$ gm.) as against $.1$ gr. for Taxilan specimens. The question as to this correlation value being a characteristic of all coinage regardless of period and denomination can only be settled by numerous observations on other currency. However, an affirmative result need not be taken as surprising because r measures the strength of association between time and weight in a manner that is independent of the unit of time, and of weight, therefore independent of the rate of wear. It is just possible that the extent to which date of issue is relevant information as regards the mean weight of the group remains the same over a large geographical region and great duration of time.

The next step is to examine whether the correlations give equally good linear regressions in both cases. The relevant information is summed up in Table I.

This increases the resemblance between the two coinages, as we see that the regression is very highly significant in both cases, and that the deviations from regression are just over the $.1$ p. c. level of significance, when tested against the estimated variance within arrays, by Fisher's z test. But the story changes if we fit quadratic regressions. For British coins, the deviations from a

TABLE I

	D. F.	Sum Squares	Mean Squares
<i>British</i>			
Lin. regression ..	1	15423	
Deviations from regression	16	1130	70.63
Within arrays ..	2868	65563	22.86
TOTAL ..	2885	82116	
<i>Taxila</i>			
Lin. regression ..	1	20712	
Deviations from regression	9	2389	265.44
Within arrays ..	742	73502	99.58
TOTAL ..	752	96603	

(Figures rounded off from machine calculations.)

quadratic regression have the sum-square 1092, which with the loss of one degree of freedom actually makes the deviations a little more significant; in the Taxilan case, we have the sum-square reduced to 938, which gives a mean square for deviations 117.31, quite insignificant. So, it is clear that no regression could fit appreciably better than the quadratic for Taxila, while the British deviations are due to other causes than a non-constant rate of wear with time. Both of these are to be expected, inasmuch as for all times, the tendency to get rid of a "bad" or worn coin heightens the rate of wear with age; and for Taxila ten reverse marks cover something like 120 years so that one need not expect the same rate of wear to apply throughout the period. For the British currency, the war period 1914-18 was one of absorption of coin, which flooded the market after the war and caused a stagnation of the 1918-20 issues. Besides, the time of sampling (August 1940) was one of extreme currency panic. Finally the sample taken at Poona can hardly be called truly representative of the vast numbers minted—at varying rates—and

issued according to the needs of various parts of the country. That is, the British deviations are due in my opinion primarily to inefficient sampling and irregularity of the actual date of issue of the currency in question.

Perhaps the most curious feature of the investigation was the fact that mean values for both coinages lie practically on a straight line, when the graph is drawn. But the correlations are comparatively low. I mean to show here that this is a feature common to time series in general, where the correlation as calculated from the usual formula must necessarily be an underestimate of the population value. For the case in hand, theory proceeds on the assumption that the minted weights show a normal distribution, and that the loss due to wear is also normal. With these (or slightly more general) assumptions, we are led to what is known as the homogeneous random process, which is fundamental in the flow of heat, diffusion, the kinetic theory of gases, Brownian movements, the theory of speculation, and certain actuarial phenomena. For our purpose, it is enough to deduce that the means are regularly depressed with age, the variance increased; both obeying equations linear in time. There is an additional factor for absorption of currency, of type $\exp -bt$, but this does not affect weight distribution within an array. It is also seen that the numbers in one array are independent of those in another unless the rate of issue is constant and that of absorption is known to be exact. All this does not give us a population in bivariate normal correlation. For a population of this latter type, one finds (in representative samples) the entries vanishing outside of an elliptical region of the tables, and the numbers thinning out towards the boundary of this ellipse; and this is theoretically to be expected. In a time series in general, there is no reason for this to happen. In fact, for a time series, the variance of the time is usually infinite, the ellipse of error being then drawn out into two straight lines. All the arrays, for such a time series, taken together only amount to a very thin slice taken from near the centre of a proper distribution in bivariate normal correlation.

One should not be surprised, therefore, if the calculation of r by the usual formula leads to something entirely different in the case in hand. To take a theoretically perfect example, let there be $m+1$ arrays labelled $0, 1, \dots, m$; in the p th array, let

the number of specimens be n_p , their mean weight $a - bp$, the sum of squares of the deviations from the array mean $n_p(u^2 + pv^2)$. The average weights then lie exactly on a straight line, and the population correlation should be unity. But calculating by the usual formula we obtain

$$r^2 = \frac{b^2(\beta - a^2)}{u^2 + av^2 + b^2(\beta - a^2)}$$

$$\text{where } N = \sum_0^m n_p; \quad \frac{1}{N} \sum_0^m pn_p = a;$$

$$\frac{1}{N} \sum_0^m p^2 n_p = \beta.$$

Moreover, the sum of squares within arrays is $N(u^2 + av^2)$, that between arrays being $Nb^2(\beta - a^2)$; so, in place of the correlation coefficient r , we have actually obtained the correlation ratio η and unless the variation vanishes in each array (which is theoretically impossible) r^2 (here η^2) is always less than the population value (here unity), which can be approximated only by increasing the number of arrays indefinitely, not by merely taking more and more coins in a finite number of arrays. In fact that latter process leads to a quantity distributed not like the square of the correlation coefficient, but asymptotically like χ^2/N , which function has also been proposed as a measure of the correlation in place of r , or η .

In practice, the r^2 calculated as above amounts to taking the ratio of the sum of squares due to regression to the total sum of squares. In its place, I suggest that for time series the sum of squares due to regression be divided by the total sum of squares between arrays for an estimate of ρ^2 which amounts to calculating the correlation coefficient from the weighted array means. This is a better estimate of the "population value", and the degrees of freedom are now based on the number of arrays alone. These "adjusted" correlations are, for Taxila $\bar{r} = .946$; rupees $\bar{r} = .965$. Of course, this should be applied only to time series as such, in which it is known that the time variate has not a finite variance, and does not yield a population in bivariate normal correlation.

Tests of significance by analysis of variance might be justified in all cases. But those who insist upon the validity of the usual formula for r even in the time series would find it difficult to say just what population constant is estimated thereby. A population is said to be in bivariate normal

correlation when its probability density is given by

$$\frac{1}{2\pi\sigma_1\sigma_2\sqrt{1-\rho^2}} \exp - \frac{1}{2(1-\rho^2)} \times \\ \times \left\{ \left(\frac{x}{\sigma_1} \right)^2 + 2\rho \frac{x}{\sigma_1} \frac{y}{\sigma_2} + \left(\frac{y}{\sigma_2} \right)^2 \right\},$$

where s_1, s_2, r are estimates of σ_1, σ_2, ρ . Taking, for simplicity, $\sigma_1 = \sigma_2 = \sigma$, the axes of the error ellipse are found to be proportional to $\sigma\sqrt{1+\rho}$, $\sigma\sqrt{1-\rho}$. Making ρ tend to unity while σ approaches a finite limit means letting the ellipse shrink down to one of its axes as a line segment. The bivariate

population then degenerates into one with a single variate whose variance is easily found from the corresponding axis, while the other axis tends to zero length. But in order to represent the usual time series, the ellipse must degenerate in other ways, a simple example being $\rho \rightarrow 1, \sigma\sqrt{1-\rho} \rightarrow a$. Here, one of the two axes becomes infinite, the other remaining finite. The ellipse is then stretched out into two parallel lines. Without an entirely new definition, the "population correlation" here can only be taken as unity. Attaching the usual meaning to the r formula is, therefore, now out of the question.

COMMENSALISM IN SPONGES*

BY

D. W. DEVANESEN AND P. I. CHACKO

(Department of Industries, Madras)

WELL-KNOWN examples of commensalism in the animal kingdom are found between crabs and sea-anemones. The sea-anemone *Adamsia* lives in association with a hermit-crab. The crab *Dorippe* carries a sea-anemone on the top of a bivalve shell which is mounted on its back and held in position by its hind pair of legs. But among the Krusadai littoral fauna are found instances of commensalism in siliceous sponges which being extraordinary deserve the special notice of naturalists.

(1) The sponge *Spirastrella inconstans* (Dendy) has imbedded in the outer portion of its body numerous cirripedes of the species *Balanus longirostrum* (Hoek). The sponge belongs to the family *Clavulidae* of the order *Tetraxonida*. It is common all round the island, especially on the south-western side. The sponge is composed of a bunch of stout, erect, digitate processes springing from a basal mass. Its colour is light brown; and it is often washed ashore. The cirripedes evidently draw their supply of food through the current of water set up by the choanoflagellate cells of the sponge. The cirripedes have therefore to expend little or no energy in producing the current. In return the sponge probably gains mechanical support by the inclusion of the exo-

skeleton of the cirripedes. The sponge may also help itself to surplus food-material broken by the cirripedes into finely divided grains. The number of barnacles in a sponge is very variable; but on an average there are fifteen barnacles to thirty-five grammes of the sponge, thus showing that the barnacles are rather sparsely distributed.

(2) The sponge *Adocia dendyi* (Burton)¹ is another example; but here the commensal is an alga, *Ceratodictyon spongiosum* (Zanard).² Further, as this is an intimate association between an animal and a plant, it is an example of symbiosis. For the symbiotic life sunlight is necessary. As the host occupies shallow flats, sunlight can reach the alga and photosynthesis is possible, the alga liberating oxygen for the choanoflagellates from the carbondioxide supplied by the latter. The sponge belongs to the family *Haploscleridae*, of the order *Tetraxonida*. The sponge is found all round the island within the one-fathom zone, and is frequently washed ashore by waves. The alga belongs to the family *Gracilariaceae* of the group *Rhodophyceae*. The sponge when fresh is light green in colour. In this case also, the sponge does derive some rigidity by the presence of the branching alga.

¹ The sponge was identified Dr. by M. Burton, D.Sc., of the British Museum, London.

² The alga was identified by Prof. M. O. Parthasarathy Iyengar, University of Madras.

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REVIEWS

Physical Constants of Hydrocarbons. By Gustav Egloff. (Reinhold Publishing Corporation, New York), 1940. Pp. 605. Price \$12.00.

The present volume is the second of the four-volume work on the collation and systematic study of the important physical constants of different classes of pure hydrocarbons. In the first volume which was published in March 1939 (*cf.* this Journal), physical constants of the paraffins, olefins, acetylenes and other aliphatic compounds were fully described. Physical constants of cyclo-paraffins, cyclo-olefins, and other alicyclic compounds are reported in this volume which in 605 pages covers nearly every known pure hydrocarbon in these series. The enormity of the task can be gauged from the fact that alicyclic hydrocarbons are available in nature in enormous quantities. Of the oil production of the world for 1939 which was about 2,000,000,000 barrels, 500,000,000 were cyclo-paraffin hydrocarbons and they are largely consumed as motor fuel, gas oil, kerosene, diesel oil, lubricants and fuel for household and industrial purposes. The physical constants of the alicyclic compounds have not been studied with the same degree of accuracy as those of the paraffinic series owing to the recognition of their special advantages only during recent years.

The book deals with a brief introduction on the subject and includes such important considerations as:

- (a) Structure of alicyclic hydrocarbons,
- (b) Mono-cyclic rings of the alicyclic series,
- (c) Cycloparaffins containing fused rings,
- (d) Double and triple bonds in alicyclic hydrocarbons,
- (e) Geometrical isomerism, and
- (f) Nomenclature of alicyclic hydrocarbons.

Four physical constants namely the melting point, the boiling point, density, and refractive index for every compound are given in as many cases as literature makes it possible. Additional data are occasionally given which add to the value of these constants and establish their accuracy. The volume is really a dictionary of constants and the reviewer has very little to add ex-

cepting to confess that the work is a strenuous effort which must have cost lot of patience and time and should be utilised by workers in petroleum industry and students of hydrocarbon chemistry. Further research, however, will probably lead to many corrections in the actual values of the constants, as it is only during recent times that the need for a systematic study of the physical properties of pure hydrocarbons has been felt.

In these investigations on the purity of hydrocarbons, new physical discoveries such as Raman effect, the molecular scattering of light by pure substances and the X-ray methods of analysis have already played an important part. Other physical properties such as dipole moments and viscosities will probably be of equal importance and the constants obtained by the methods will probably find a fitting place in new editions of this otherwise useful book.

S. S. B.

Hydraulic Measurements—A Manual for Engineers. By Herbert Addison. (Messrs. Chapman & Hall, Ltd., London), 1940. Pp. x + 301. Price 21sh.

This book forms a companion volume to the author's earlier work "A Text-Book of Applied Hydraulics" which has now run through the second edition. It is mainly intended to be a practical manual for engineers and gives experimental details for all the methods available for the measurement of the pressure and flow of liquids. The progress made during the last two decades in the scientific study of the laws of hydraulic flow has enabled the author to formulate the laws on a more stable basis than hitherto. He has also given full weight to the practice adopted on the continent and embodied in the book *the work of Irrigation Engineers in Egypt and India*. Now-a-days, when more and more attention is being paid to the metering of city water supplies, the methods described for stream gauging will be found very useful by Municipal Engineers. Similarly, due to the development of the oil and petroleum industries and the immense increase in the use of liquid fuels, the metering of piped discharges has assumed very great

importance and the book deals exhaustively with this.

The author assumes considerable acquaintance on the part of the reader with the theory of Hydraulics and no theory is given regarding any meter or instrument. An actual meter is described and the method of using it with all possible sources of error and necessary precautions to be taken are given in detail.

The whole of the first chapter is devoted to direct reading meters for the measurement of depth, head and pressure and the second chapter with indirect reading meters. Installation and operation of pressure and depth gauges is dealt with in the 3rd chapter and the next three chapters deal with the measurements of weight and volume, velocity and discharge. The measurement of discharge in closed pipes is dealt with under three heads, (1) Quantity meters, (2) Rate of flow meters, and (3) special methods and a separate chapter is devoted to each. Similarly, the measurement of discharge in open streams, by free flow methods, by weirs and flumes, and by regulating sluices and by scale models is discussed in great detail, each occupying one separate chapter. The twelfth and the last chapter deals completely with indicating, recording and integrating instruments for flow-measuring installations.

The author has made the actual use of each and every appliance mentioned in the book more intelligible by the introduction of photographs and hand sketches wherever possible. One very attractive feature of the book is that any doubts that one may have with regard to the practical use or calculations relating to any meter, are cleared by the profuse introduction of worked examples at each stage.

E. K. RAMASAMI.

An Introduction to the Study of Air Mass and Isentropic Analysis. By Jerome Namias. (American Meteorological Society, Mass.), 1940. Pp. 232. Price \$1.25.

The book is a valuable asset to every student of meteorology. A number of experts have made contributions to it, and its popularity is shown by the present edition being the fifth edition in five years.

The book opens with an introduction by J. Namias and a discussion of the conditions of atmospheric stability, and the properties best conserved by air masses during their movements, properties by which they can

be identified and distinguished. The Rossby diagram, its interpretation and applications are dealt with in two sections, followed by three sections devoted to warm and cold 'fronts' and the elements of cyclonic structure. The Norwegian wave theory of cyclones is expounded in a few pages by B. Haurwitz. The eighth section deals with the 'Tephigram' of Shaw and its application in forecasting weather by a study of the upper air. A study of the origin, classification and forecasting of thunderstorms is given in the next section.

Having shown that a study of air masses and fronts, and their movements and modifications is of great importance in explaining and forecasting weather, in the next part of the book, pp. 72-108, H. C. Willet takes up a detailed study of the sources, classification and characteristic properties of North American air masses, their movements and modifications and their significance in weather production. These studies are continued in pp. 109-113 by Al. K. Showalter, and the following pages 114-35 contain charts illustrating the features and phenomena described.

Section 10, pp. 136-75 by J. Namias expounds the analysis of meteorological factors and events through a study of 'isentropic' surfaces, with a number of illustrations and charts. The importance of upper air data for such analysis is brought out.

A noteworthy feature is the very extensive and detailed bibliography, pp. 176-227, classified under 10 headings and 27 sub-headings, with over 1,900 references. The last five pages contain a glossary of technical expressions. The different recent methods of analysis of meteorological data for the study and forecasting of weather are explained in the book in a concise manner with illustrative charts on a large scale. No keen student of meteorology should be without a copy of this book.

A. VENKAT RAO TELANG.

Handbook of Economic Entomology for South India. By T. V. Ramakrishna Ayyar. (Government Press, Madras), 1940. Pp. xviii + 528. Price Rs. 4-12.

According to the author the book has been compiled from lectures delivered by him to the students of Madras Agricultural College for over twenty years and is especially intended for agricultural students and educated farmers of South India.

Part I of the book deals with general entomology, in a lucid and simple style showing the position of insects in the animal kingdom and their importance. It then deals briefly with the external and internal system, physiology, reproduction and growth of insects, the general features in the activities of insects and lastly with insect classification. The most important feature in Part I is a simple key to recognise the important insect groups of South India. This key in most cases should make it possible to quickly locate the order of any common insect of importance referred to in the book and will be helpful to all agricultural students in India.

Part II deals with economic entomology, insect pests of cultivated plants including the chief agricultural crops of South India, vegetables, fruit trees and of other plants yielding dyes, drugs, spices, etc. This part also acquaints the reader with pests of garden plants, fodder crops, some useful trees of the plains, pests, affecting food products, cattle and domestic animals. There are also brief references to methods of control of the various pests. The author has also briefly dealt with household, and disease-carrying insects and a few beneficial insects of productive and helpful forms. The book ends with four useful appendices and a list of reference to literature on South Indian Entomology.

In short, the book is packed full with information on the various aspects of entomology and is not only a good text-book for agricultural students but an attractive guide to those whose interest in entomology is casual.

An outstanding feature of the book is the abundance of illustrations most of which are clear and simplified but in a few important cases the simplicity and clearness have been marred by reduction in size, overcrowding of many figures in one illustration and faint lettering, e.g., in Fig. 3A, it is difficult to read names of bones and in 3B it is difficult for a beginner and a layman to find out what and where the chitinous exo-skeleton is; Figs. 60 and 61, illustrating several biting and sucking insects along with the nature of damage caused by them, have been crowded together, making the illustrations less informative and educative about the form of the insects and nature of the damage caused by them; Figs. 76 and 77 which respectively illustrate the calendar

of important pests of chief crops other than paddy and Madras insects which become pests only in certain years, the food plants, insect pests and lettering are not prominent and clear; this has greatly affected the value of these illustrations.

The author has been unkind to the insect world by reducing their estimated population from seventy-five to sixty per cent. of the living species of animals. American spellings have been introduced here and there; on page 28 one of the definite functions assigned to fat bodies is that of excretory organs though the opinions of workers greatly vary on this point. In spite of the earnest attempts and appeals of the entomologists to follow uniform terminology words like 'deterrents' have been used for 'repellants', etc.

Under chemical methods of insect control by the use of non-arsenical materials like sodium fluoride which are more in use these days for treating vegetables and fruits against biting insects, short notes on use of easily available ones would have been useful to the farmers.

To the reviewer's regret, the author has made certain inaccurate statements in the chapters on beneficial insects, e.g., Lac is called an ingredient of shellac when in fact shellac is nothing but purified lac; the name of the most common lac insect has for some years been changed to *Laccifer lacca* but the author still calls it *Tachardia lacca*; there are both apterous and winged males among the lac insects, the former class being more prevalent but the author has mentioned only winged males; even the winged male does not fly out of its resinous covering as stated by the author but crawls out like an apterous male. The scraped lac when coarsely crushed and washed is called 'seed lac' and not 'lac'. Shellac is not made by boiling 'the powdered seed lac encrustation with a chemical like yellow arsenic or orpiment' but by filling the seed lac in a long narrow bag, melting it and forcing it through the cloth by pressure; the orpiment is not at all necessary for this purpose but is sometimes used only to lighten the colour of dark coloured lac. In the list of provinces where lac is cultivated on a fairly large scale, omission of Bihar which produces over three-fourths of the total production is regrettable. Mistakes of this type could have been easily omitted if recent publications on lac had been referred to. In his own

province of Madras, the author has mentioned his own small efforts of growing lac on certain hosts but has not mentioned large-scale lac cultivation by the Madras Government in Salem and Madura.

Either adding another appendix or arranging appendix 'A' according to important food plants and giving the names of chief insect pests with their orders in brackets against the food plants would prove more useful and handy to the readers than the present arrangement. In spite of the errata, there still remain a few printing errors which perhaps are inevitable in a first edition. The printing also is not as attractive and neat as it should be for such a useful book.

These criticisms, however, do not detract from the enormous value of the book to those for whom it is especially meant. It is also patent that the author took great pains in preparing his college lectures and finally compiling the present book which should prove more useful to the agricultural students and educated farmers in India than some books on foreign agricultural entomology now in use in India.

P. S. NEGI.

Principles and Practice of Chromatography. By Zechmeister and Cholonoky. English translation by Bacharach and Robinson. (Chapman & Hall, Ltd., London), 1941. Pp. 362. Price 25sh.

Few will disagree that science advances as much through presentation of an important problem as through the invention of a new technique. Referring to the latter some twenty years ago Emich and Pregl perfected the method of micro-analysis to such a degree that many a chemical problem could now be attacked which was previously given up as impossible. During the last ten years the "Chromatographic procedure" has likewise revolutionised chemical manipulation, both in isolation as well as in purification of compounds. For example Lactoflavin or Vitamin B₂ is present as traces in milk; it was impossible to isolate it by any other technique. It was finally concentrated by adsorption on alumina and recovered through elution by means of benzene and methyl alcohol. Among cancer producing hydrocarbons it was necessary to obtain substances in an ultra-pure condition since their potency was apparent when they were present even

in traces. Dibenzanthracene as ordinarily obtained was accompanied by a trace of an yellow coloured impurity. The classical methods of purification were all found useless for purifying dibenzanthracene; the purification was achieved by the application of chromatography.

Chromatography was developed by the Russian Botanist, Tswett, in 1906 but was entirely neglected until the German Chemist, Richard Kuhn used it in isolating Lactoflavin in 1931 and several polyene pigments subsequently and thus showed its importance.

So much work has been done by its help within these ten years that enough literature has grown up to be embodied in a book originally written in German by two Hungarian scientists, Prof. Zechmeister and Dr. Cholonoky which underwent two editions, the last appearing in July 1938. Drs. Bacharach and Robinson of the Glaxo Laboratories have translated the book to which Prof. Heilbron has written a short foreword. The translation is published by the well-known firm Messrs. Chapman & Hall and the book covering over 370 pages of printed matter and containing 74 illustrations is moderately priced 25sh.

The half-tone blocks seem to have been lent by Julius Springer of Vienna the publishers of the German edition; some of the illustrations show the presence of spots which do not interfere with their explanatory value but do reduce their artistic standard. Fig. 20, for example, has two black spots in the background and a white one on the neck of the flask. Fig. 68 again has two white spots and is moreover printed upside down as compared with the German original. The Germans write exhaustively, the French lucidly. The English translation has followed the French method by abbreviating the bibliography and omitting titles of the papers carefully given in the German original and leaving only the references to publications. The taste for clarity is very apparent in the translation. For the original "Kunsblich bereiteete Porphyrin Praparate" the English edition states "Synthetic Porphyrins" which is as lucid as it is precise. Many such examples could be given which makes the translation even superior to the original. The sub-titles of smaller paragraphs are often found at the beginning of their sentences in the German book. The translators have given them the importance they deserve and printed the

headings in thicker type and by themselves at the top of each paragraph. For example the German edition says on page 185: "(a) Absorptionen verhalten einiger basischer Farbstoffe" running in one sentence the English version prints as follows:

"(a) Basic Dyes.

The order in which a number of basic dyes"

The original text itself is not written in the characteristic heavy style of the Germans but the English translation makes the contents even more easily assimilable. The English rendering is so well done that the

work no where reads like a translation and the meaning is everywhere more clearly expressed than in the original. Even if one were able to read German without the help of a dictionary we would recommend the English translation.

Finally we wish to endorse what the publishers communicate on the wrapper "This is the first account of Chromatography to be published in English and the first book dealing exclusively with a subject that has already proved of enormous value in different fields of research."

S. M.

PHYSIOLOGY OF RESPIRATION OF THE AIR-BREATHING FISH, *MONOPTERUS JAVANENSIS* LACÉPÈDE [=*FLUTA ALBA* (ZUIEW)]:-A REVIEW

MARKED seasonal changes, especially in regard to the alternation of dry and wet periods, in the climatic conditions of India have resulted in a number of interesting adaptations in certain fishes of the country. The most remarkable among such adaptations is the habit acquired by some forms to make direct use of the atmospheric air for tiding over periods of drought when the waters in which they live either become very stagnant or dry up altogether. Though this habit has been acquired by many species in a greater or lesser degree, depending on the environments in which they live, the end in view is the same in all cases; the means adopted for its achievement and consequently the structural modifications undergone by the various fishes belonging to widely separated families are, however, quite different. The highly interesting subject of aerial respiration in fishes attracted the attention of not only the earliest ichthyologists who investigated the Indian fauna but is still being studied by a number of students both in this country and abroad. With the advances in the technique for carrying out physiological experiments, the mass of data collected within recent years has materially helped to elucidate the nature and cause of evolution of this remarkable phenomenon. In a recent contribution on the subject, Wu and Liu (The Bucco-Pharyngeal Epithelium as the Principal Respiratory

Organ in *Monopterus javanensis*, *Sinensia*, April 1940, Vol. XI, pp. 231-38), as a result of direct observations and a series of illuminating experiments, have been able to establish that in *Monopterus javanensis* the bucco-pharyngeal epithelium, serves as the principal respiratory organ, both in air and water; they have also been successful in elucidating the exact rôle of the gills and the skin in this vital process. Finally the authors studied the morphological features of the branchial apparatus of the fish with a view to ascertaining the rather limited function of the gills and the capacity of the fish for cutaneous respiration.

Wu and Liu describe in detail the mode of respiration of *Monopterus* and show that for six-tenths of the period the fish remains in a state of suspension, three-tenths in the aerial phase of respiration, and only one-tenth in the aquatic respiring phase. They fully support the reviewer's views (Physiology, Bionomics and Evolution of the Air-breathing Fishes of India, *Trans. Nat. Inst. Sci. India*, 1935, Vol. I, pp. 1-16) with regard to the less laborious nature of the aerial as compared with the aquatic respiration, higher efficiency of the aerial respiration in obtaining oxygen and, in consequence, only a small expenditure of energy on the part of the animal adopting this mode of obtaining air. From the results of their elaborate experiments on the efficiency of

the aquatic respiration in *Monopterus*, the authors conclude that "provided the supply of dissolved oxygen is sufficient, *Monopterus* can live under water indefinitely". In this respect also, the reviewer's (Physiology of Respiration and Evolution of Air-breathing Fishes, *Proc. Nat. Inst. Sci. India*, 1939, Vol. V, pp. 281-87) experimental data are fully supported by the Chinese workers. It is, however, remarkable to note that Das [Nature and Causes of Evolution and Adaptation of the Air-breathing Fishes (A resume), *Proc. 27th Ind. Sci. Cong.*, 1940, pp. 215-60] still holds that under no circumstances branchial respiration alone is quite sufficient for the maintenance of life in the case of the air-breathing fishes of India. A series of experiments undertaken by Wu and Liu to determine the chief organ of aquatic respiration of the fish—since the gills are greatly reduced—showed that whereas respiration by the gills and the skin could not maintain its life, that by the bucco-pharyngeal epithelium can. Thus it has now been experimentally demonstrated, what was pointed out by the reviewer in 1935, and reiterated in 1939, that aquatic and aerial respiratory surfaces are capable of interchanging their functions. The structures of the branchial apparatus

and the skin of *Monopterus* are described and the general conclusion is reached that:

"The gill of *Monopterus* is rudimentary inasmuch as the respiratory area has been greatly reduced. It has been proved to be physiologically dispensable, and the fish is likely to be 'drowned' if it depends solely on its gills for respiration. The skin possesses little histological specialization to facilitate the exchange of gases, and its capacity for cutaneous respiration is necessarily of meagre extent. The bulk of the work of respiration falls upon the bucco-pharyngeal epithelium, which now becomes the principal respiratory organ in function. Though habitually employed as the organ of air-breathing, the bucco-pharyngeal epithelium proves effective for aquatic respiration also, and by means of which *Monopterus* is able to live almost indefinitely under water or in air without the aid of gills, provided suitable physiological conditions are established. Structurally the bucco-pharyngeal epithelium is very simple and generalized on the whole, but it seems to be a perfect adaptation in itself, and its utility is even greater than the pharyngeal 'lung' of an allied fish, *Amphipnous cuchia*"

S. L. HORA.

CENTENARIES

Common, Andrew Ainsle (1841-1903)

ANDREW AINSLE COMMON, a British astronomer, was born at Newcastle-on-Tyne August 7, 1841. Owing to his father's premature death, he joined his uncle in a firm of sanitary engineers in London. But even as a boy of ten he had shown an interest in astronomy and when he settled in London, he revived this interest and set up a telescope in his house in 1874 and joined the Royal Astronomical Society.

By 1878 he had made sufficient observations with a silver-on-glass mirror of eighteen inches diameter to contribute a paper on the *Satellites of Mars and Saturn*. After five years of hard work, he completed in 1886 a five-feet equatorial reflecting telescope which was later taken over by the Harvard College Observatory. He made several mirrors and presented some to the Royal Society to make observations on the eclipses and some bigger ones to various other observatories.

Common was a pioneer in the application of photography to heavenly bodies. For he was practically the first to develop and describe its possibilities in a paper published in the *Monthly*

Notices in 1879. In 1881 he photographed the great comet of that year. This is the first recorded photograph of a comet. In 1882 he took a magnificent photograph of the great nebula of Orion. Thus he opened the way for further strides in astrophysics.

As a mark of appreciation of his successful attempt at astronomical photography, the Royal Astronomical Society awarded its gold medal to Common in 1884. He was elected F.R.S. in 1885 and became its president during 1895-97. He became an LL.D. of St. Andrews in 1891 and became the first president of the Astronomical section of the British Association which was formed in 1900. His address gives an elaborate history of the construction of astronomical instruments in the nineteenth century including his own work on reflecting telescopes. His address contains the prophetic statement "Photography also comes in as a further aid to the telescope, as it may possibly be to the microscope".

Common died suddenly of heart failure at his house at Ealing June 2, 1903.

S. R. RANGANATHAN,

University Library,
Madras.

OBITUARY

DR. RABINDRANATH TAGORE (1861-1941)

WE deeply mourn the death of Rabindranath Tagore on Thursday the 7th August in his residence at Calcutta. He was a universal figure venerated all over the civilised world as a poet, a philosopher and a seer. He travelled far and wide, and in most cities of the world, surging crowds were held spell-bound by the melody of his voice, by the inspiration of his addresses and by the fullness of his love and sympathy. There is scarcely any language into which his more important verses have not been translated. No poet, ancient or modern, has received during his lifetime the honour and reverence with which Dr. Tagore has been greeted both in the East and the West. Indeed Keyserling has aptly described him as the most encompassing human being ever known.

His literary achievement is prodigious. It overshadows everything else. His writings have influenced the cultural and spiritual life of Bengal as nothing else has done during the last fifty years. He is however essentially a lyrical poet; and his poems have a universal appeal for they are always the expressions of his unique personality. As he himself says, "When our heart is fully awakened in love or in other great emotions, our personality is in its flood tide. Then it feels the longing to express itself. Then it is that the notes of our music and song try to fathom the depths of the ineffable." Thus when *Gitanjali* was published in English translation in 1912, it was received with raptures that were almost bewildering. Maeterlinck thought that the passages in that book would rank among the loftiest, the most profound and most divinely human ever written. And he was soon awarded the Nobel Prize in Literature.

Rabindranath is also justly famous in the rôle of a teacher of youth. The memory of his own school days was un-

happy. A method of discipline which refused to take account of the individual and was designed for grinding out uniform results was repugnant to his whole temperament. It was fortunate that he was allowed to study at home in his own way. It is this unhappy memory of his childhood which prompted him to break new ground and establish an "Ashrama" in the rural surroundings of Santiniketan. He always wished that the young mind should be saturated with the idea that it has been born in a human world which is in harmony with the nature around it. The highest education is that which does not merely give us information but brings us up in harmony with all existence; and visitors to Santiniketan will never forget the early morning song which wakes them up from sleep—the boys singing in chorus and praying that they might expand into love of nature, of beauty and of God. He never had any feelings of distrust about the boys' capacity of understanding. No songs he would give to the outer world until he has sung it himself to his juvenile audience. All his plays must first be staged in Santiniketan by the boys and the girls of the Ashrama acting under his own direction. No pronouncement on the burning topics of the day, but the first listeners will be the disciples in the Ashrama. He held very high this ideal of education through sharing a life of high endeavour with one's master, —the teacher prosecuting his own studies, living a life of simplicity and helping the students in their lessons as a part of his life and not of his profession. In Santiniketan he recaptured for himself the meditative calm of ancient India and lived in the tradition of our ancient rishis.

There are few people who now remember that in the first decade of this century, Rabindranath was an active participant

in the rough and tumble of politics. His national songs were sung in almost every political demonstration that followed the partition of Bengal in 1905. His eloquent speeches in Bengali moved vast audiences to whom the English oratory of Surendranath Banerjee carried no meaning. He became a priest of the National Revival and assailed foreign rule with increasing vehemence. He extolled the valour and self-reliance of the heroes of India in most exquisite ballads, which together with his national songs have become a priceless possession of the Bengali literature. But when in the wake of this revival of political consciousness, came the cult of the bomb for recovering national freedom, Rabindranath withdrew from active politics. He strongly felt that this cult of terrorism was fundamentally opposed to the spirit and teachings of our sages. And when Mahatma Gandhi began preaching his plan of winning freedom through non-violent conscious suffering, Dr. Tagore accepted this doctrine with alacrity and gave expression to it in magnificent words:—

"I hope the spirit of sacrifice and willingness to suffer will grow in strength. For to achieve this is an end in itself. This is the true freedom. Nothing is of higher value, be it national wealth or independence, than disinterested faith in the moral greatness of man. The West has its unshakable faith in material strength and prosperity. And therefore however loud grows the cry for peace and disarmament, its ferocity growls louder. We in India shall have to show to the world what is that Truth which not only makes disarmament possible but turns it into strength. Life, in its higher development, has thrown off its tremendous burden of armour and a prodigious quantity of flesh till man has become the conqueror of the brute world. The day

is surely to come when the frail man of spirit completely unhampered by arms, airfleets and dreadnaught will prove that the meek is to inherit the Earth. The destiny of India shall choose for its ally Narayana and not Narayanasena, the power of soul and not that of the muscle. Our fight for Swaraj is also a spiritual fight. We are to emancipate Man from the meshes that he himself has woven round him—these organisations of National Egoism. The butterfly will have to be persuaded that the freedom of the sky is of higher value than the shelter of the cocoon. If we can defy the strong, the armed, revealing to the world the power of the immortal spirit, Man will find his Swaraj; and in winning such freedom, we shall win freedom for all humanity."

One cannot help recalling that Rajah Ram Mohan Roy, the father of modern Indian Renaissance, had Maharsi Devendranath Tagore as his foremost disciple and Rabindranath was the youngest son of that disciple. Rarely do we witness such a succession of greatness in the history of a country to mould the spiritual and national life of its people for more than a century. These were noble spirits who were called to surrender themselves to the quest for the Heaven of Truth and Freedom. When the chaos of the modern world would burn deep his sensitive soul, Rabindranath would sing:

"Where knowledge is free,

Where words come out from the depths of
Truth

Where the clear stream of Reason has not
lost its way into the desert sand of
dead habit,

Unto that Heaven of Truth and Freedom,
my Father, let my country awake."

To readers of *Current Science*, what message could be more inspiring than the call to join this quest!

INTER-UNIVERSITY BOARD, INDIA ANNUAL REPORT, 1940-41

THIS Annual Report of the Inter-University Board indicates the action that has been taken in regard to the various resolutions passed by the Board in previous years and it also refers to the correspondence that has taken place on certain important questions of common interest to universities. Reference may be made in this review to some of the outstanding matters contained in the Report.

The question of providing separate courses of study for women candidates in the universities had been recommended by Resolution XII of the Board at its Waltair Session. But from a glance at the replies received from the various universities in this connection it would appear that opinion is somewhat sharply divided. Some universities evidently consider it undesirable to make any difference between men and women in regard to the degree courses. Some others seem to think that differences may be made in the diploma courses only. Still others express no opinion at all. Only two or three are altogether in favour of the proposal. Again, a few would content themselves with the inclusion of only one or two subjects which may be of special interest to women, but would go no farther.

It is difficult to understand why there should be so much difference of opinion when once it is conceded that men and women have different rôles to fulfil in life and that they therefore require differential training. But it is probably feared that the subjects proposed for women may not be of a sufficiently intellectual character for being included in university courses on terms of equality with the other subjects. It must be remembered, however, that much depends upon the manner in which these subjects are dealt with in the classroom. Another objection may come from the women themselves who may look upon their special subjects as inferior to the usual academic studies in point of the mental discipline which they provide. This difficulty may be avoided, to some extent, by offering free choice to the women. If this is done, it is likely that the inferiority complex may disappear in course of time. Whatever the difficulties may be, there

is no reason why universities should hesitate to take a step which is obviously in the right direction.

A second important question relates to the forming of a film library suitable for university purposes. The value of cinema films in all stages of education is being increasingly recognized in these days. In U.S.A. educational films have been carefully and extensively developed in recent years; and, but for the war a similar expansion would also have taken place in Europe. India is a poor country, and the setting up of a film library for university use must therefore be a co-operative enterprise. It is therefore gratifying to note that almost all the universities in the country have expressed their willingness to take part in the venture.

The resolution inviting the co-operation of Indian universities in the work of adult education in this country has evoked a variety of replies, mostly unfavourable. The problem in India is not on a par with what is described as the problem of adult education in the advanced countries of the West. There, it is a question of giving further education to those who have already had elementary schooling; whereas here in India it is a question of promoting literacy among those who never went to school. The appropriateness of universities undertaking this latter task must remain an open question. If, on the other hand, the co-operation of the universities is requested for what corresponds to the University Extension Movement in England, then the matter certainly deserves support.

Lastly, the proposal for exchange of professors as between universities has been regarded favourably in most quarters; but some universities have expressed doubt as to its practicability. It is to be hoped, however, that the practical difficulties will soon be overcome and a workable scheme will soon be put through. There is no doubt that exchange among university staff will let in some fresh air into lecture halls whose atmosphere often tends to deteriorate for want of renewal.

D. S. GORDON.

SCIENCE NOTES AND NEWS

A Hymenopterous Parasite.—*Probarryconus indicus* (Kieff.) recorded for the first time from India.

Mr. P. V. Isaac, Imperial Agricultural Research Institute, New Delhi, writes:—

While examining sugarcane for insect pests at the Agricultural College Farm, Poona, during April 1941, a few leaves with midribs having reddish-brown irregular patches on the upper surface were noticed. On splitting open such patches, grubs of a hymenopteron were found inside a smooth cell. These grubs pupated inside the cell as naked pupæ. The adult wasps emerged out through holes on the under-surface.

The specimens are found to be *Probarryconus indicus* (Kieff.), not so far recorded from India. It was originally described by Kieffer (*J.J. Zeitschr. Hymen. Dipt.* VII, 1907, p. 311) from Java. No host of this parasite is mentioned by him. No other information is available about this insect. The group of parasites to which this belongs, the Proctotrypoidea, are known to attack the eggs of Orthoptera, especially of Acrididae and Locustidae. Very likely this wasp, collected in Poona, is parasitic on the eggs of some Locustid which lays its eggs inside the midrib of sugarcane.

Permeability in Monolayers.—A modified form of evaporant has been employed by Sebba and Rideal (*Trans. Far. Soc.*, 36, 273) to measure the rate of diffusion of water through monolayers of simple and complex films. The permeability ratio for water with various films supports the hypothesis that the rate of diffusion of water through the film depends more on the proportion of water in the film itself than on the physical state of the film. The permeability ratio has also been determined using solutions of alcohol and ammonia in water. The evaporation of both alcohol and ammonia is retarded by the monolayers. It is interesting to note that the extent of evaporation depends upon the spreading liquid in which the film-producing substance is dissolved.

M. R. A.

Relation between Nitrogen Deficiency in Soils and the Accumulation of Tannins in the Cotton Plant.—In the course of the investigations into the cause of periodical failures of the American cotton crop in the Punjab by Dastur it may be recalled that the presence of tannins was noted as peculiar to the leaves of this cotton suffering from the yellowing and shedding of the leaves characteristic of the disease. In the course of further investigations it has been found that such accumulation of tannins is connected with a deficiency of nitrogen in the soil (R. H. Dastur, *Ind. Jour. Agr. Sc.*, Vol. XI, Part II). Nitrogenous manuring increased the nitrogen content of the leaves as against controls not so manured, and in the

leaves having a higher nitrogen content tannins were absent. The border line figure for the nitrogen content deciding the presence or absence of tannins was found to be about 2.5 per cent. of the dry matter of the leaves, the tannins developing if the figure goes below this level. The test for tannin is to be made when the plant is in the flowering stage and if a positive result is obtained at this stage then it may be taken as a biochemical index of the deficiency of nitrogen in the plant. The practical value of this observation lies in the fact that the nitrogen content of the leaves can be increased by nitrogenous manuring. Where a positive test for tannins is obtained when the plant is in the flowering stage an application of sulphate of ammonia is found to greatly increase the yield and to improve the opening of the bolls. If however the soils rest on a saline sub-soil then these results do not apply. In the Punjab soils the outward appearance of the plants on such soils is sufficiently distinctive of the character of the soil and this can be taken as a reliable test to decide about applying sulphate of ammonia, even though the leaves give a positive test for the presence of tannins. These results have been confirmed by experiments conducted on the cotton fields of private cultivators also. It may be noted that even apart from the relationship of tannins to nitrogen content, nitrogenous manuring brings about a certain degree of mitigation of this disease.

A. K. Y.

Mr. Zal R. Kothavalla who has been appointed Officiating Director, Dairy Research, in succession to the late Dr. W. L. Davies, in addition to his own duties as Principal and Animal Husbandry Officer, Bangalore, is a well-known scientist, who, as Imperial Dairy Expert, did considerable work for advancing Dairy Research in this country. A number of his papers on Dairying and Dairy Products have appeared in the *Indian Journal of Veterinary Science* and other journals. He was born in 1896; after passing (1918) the B.A., of the Bombay University with specialization in Animal Husbandry and Dairying, he took the B.Sc. (Agr.) degree of the Edinburgh University and N.D.D. of Scotland (1921). He held the posts of the Dairy Superintendent of the Bombay Municipality (1922-25); Assistant to the Imperial Dairy Expert, Bangalore (1925-32), and the Imperial Dairy Expert (1932-41). He attended the ninth International Dairy Congress, Copenhagen, in 1931 as the official delegate from India.

India: 1,000 Years Ago.—The Archaeological Survey of India has salvaged from oblivion a work, pieced together from various sources, bearing on the physical, cultural and scientific progress of India and its contiguous countries about a thousand years ago by the world-

renowned oriental scholar, Al-Biruni, in the form of a Monograph in Arabic.

This reputed savant (whom Sir Aurel Stein considered the Leonardo da Vinci of the eleventh century) was one of the luminaries in the court of Sultan Mahmud of Ghazni and had extensive opportunities of obtaining first-hand knowledge of the geography of the different lands of Asia and, being a linguist of rare ability, he had an intimate knowledge of the languages, sciences, literature, philosophy, religion and beliefs of the races amongst whom he mixed freely.

The results of his observations are embodied in his monumental work entitled "al-Qanun al-Mas'udi". This monograph, which has just been published by the Archaeological Department, is an epitome of such portion of the work as deals mainly with the physical geography and mineralogy of India.

The monograph is arranged in four chapters. In the first chapter the author describes the condition of the earth in general and the geographical division of the countries in particular in relation to their latitude and longitude, illustrated by a tabular statement.

The second chapter is devoted to the genesis of the world, of primeval man and of the glacial theory, which was apparently conceived by this great scholar for the first time, as early as the eleventh century, on the evidence existing on the hilltops of Yemen (Arabia) and their neighbourhood, of fossils and fossilised bones, generally associated with aquatic animals. In the third chapter mention is made of precious and semi-precious stones and other minerals such as gold, silver, copper and iron together with their location and mode of acquisition.

The fourth and last chapter deals with (a) the vegetable world, viz., herbs, plants, fruits, drugs, barks together with their properties, usefulness and location and (b) the animal kingdom, both aquatic and terrestrial, with their characteristic nature and mode of life.

The editor, Zeki Validi Togan, a Turkish oriental scholar, wandered at large in search of Al-Biruni's invaluable works and salvaged them from different quarters of Europe and Asia. He then set himself to work on them and, after labouring hard for several years, prepared this monograph. After trying in vain to find a publisher on the Continent, he approached the Director-General of Archaeology in India, who, in appreciation of the merit of the work, decided to publish the text in advance of the English translation.

Swat Valley Expedition.—The Archaeological Survey of India has issued a monograph compiled by Prof. Evert Barger and Mr. Philip Wright, who along with Mr. T. D. Weatherhead, explored the Swat Valley and the Oxus territories of Afghanistan in the summer of 1938. The expedition was led by Prof. Barger. The object of the expedition was to trace the spread of Buddhism and hellenistic art from India, across Pamirs and the Tarim Basin, to China. "Our object in organising this expedi-

tion was a modest one. We wanted to call attention to these problems, and, by adding something to the scattered raw material, to revive the study of a subject to which British enterprise has not contributed much since the Great War outside the administered frontier of India."

The lands between the Oxus and the Indus form one vast canvas which must be studied as a whole and which was the meeting ground of three great civilizations, viz., those of India, China and the Graeco-Roman civilization of Western Asia, during the centuries between Alexander's Eastern expedition and the Islamic invasion. The Barger expedition has broken new ground in exploring the country north of the Hindu Kush, where they have explored a large number of sites in Wakhan. The discovery of hellenistic stone columns of Corinthian style at Kunduz near the Oxus is of considerable interest, as such remains have never been found north of the Hindu Kush.

In the Swat region, the British expedition excavated several sites in the Barikot District, the more important being the stupa at Kanjar Kote and the Buddhist remains at Gumbat, Amluk and Abarchinar, all on the left bank of the Swat.

Professor Barger writes: "The first tidings of Amluk, a site which had not been made known to Sir Aurel Stein, were brought by shepherds who took their buffaloes to that remote mountain top for summer pasture. These men had never seen a white man before. Until rumour reached them of our camp at Barikot and our quest for buts (idols), their only contact with European civilization had been the occasional passage of an aeroplane over their eyrie.

"Our work at Barikot had two distinct, though closely related objects. The first was a survey, as comprehensive as possible, of all ancient remains both in the three side valleys and on the right bank of the Swat river. The map which was made attempts to show not only the existing remains of stupas, monasteries and fortresses, but also those of some of their dependent villages and terraced cultivations, dead for fifteen hundred years. It was our hope that in this way it might be possible to determine the area of settlement, and the relation between domestic remains and areas of cultivation to see, in fact, what this small area looked like in Buddhist times.

"Our second object was to excavate a number of sites, not so much with a view to collecting sculpture and museum pieces, as to estimate the relation of different pieces of sculpture to one another, to examine the archaeological context in which they are found, to establish the main types of sculpture in Swat and to determine, if possible, the relation between specific pieces of sculpture and domestic objects—coins, seals, ironwork or terracottas, which because of their appearance elsewhere in a dateable context, might help to provide the beginnings of an archaeological chronology of Gandharan Art.

"Two or three more general problems must always be at the back of the mind of the archaeologist who turns to these frontier regions; why it was that such a virile, hybrid,

local art sprang up in a comparatively small area in these rocky foothills, and spread, undergoing some modification on the way, to Afghanistan and Chinese Turkistan; how such a large population—Hüen Tsiang speaks of 1,400 monasteries and 18,000 monks—was supported in these bare, now almost waterless valleys; how and when the monasteries came to be abandoned and destroyed."

Earthquakes in the Hindu Kush Region.—

A note published by the Indian Meteorological Department discusses the results of a special study of the seismological features of the strong earthquake which occurred on November 21, 1939 (at 16 hr. 31 m. 43 s. I.S.T.) in the Hindu Kush mountains.

The shock caused some structural damage at Gilgit and Srinagar and was felt with varying intensities over the whole of Kashmir State, North-West Frontier Province, Afghanistan and the north Punjab. Lahore appears to be the farthest place from the epicentre to experience the shock.

This study is based on instrumental data collected from 32 stations of the world and seismograms from the five Indian observatories and Colombo. The epicentre of the shock is located at latitude 36 degrees 11 minutes North and longitude 70 degrees, 53 minutes East in the Hindu Kush mountains, near the border of Chitral State in Afghanistan. The depth of focus is calculated about 130 miles below the earth's surface. These results are in agreement with those of the previous deep earthquakes from the same region.

Some characteristic features observed in the seismograms of this shock were found present with marked similarity in the case of the previous deep quakes from this region. Seismograms of deep earthquakes are in general more complicated and location of their epicentres more difficult than those of normal ones. But in the case of the Hindu Kush shocks it is possible to get reliable information as to their origin from the seismograms of any one Indian station.

Another remarkable aspect of the deep shocks from this region is that they are distributed in a small area round about the point 36.5 degrees North and 70.5 degrees East, from which position alone as many as 22 shocks are reported to have originated in the past 20 years. A statistical analysis shows that these shocks occur at the rate of two per year and that the strong ones exhibit a marked tendency to originate in winter. Of late, the seismic activity of the Hindu Kush appears to be on the increase.

Titanium Ore is finding increasing use in the American industry and, India by far the world's largest producer of this ore, is the United States' main source of supply.

Titanium ore, in the form of ilmenite in India, is found in association with monazite from which thorium nitrate, used in the manufacture of incandescent gas mantles, is derived and titanium ore was formerly considered a by-product of the monazite industry. In recent

years, however, it has become more important than monazite because of the demand for its contents of titanium oxide in the manufacture of titanium paints.

Titanium ores which are useful primarily because of their whitening and obliterating powers are used in the United States not only in the paint industry—their main use—but also in the rubber, linoleum, leather, plastic, soap, printing ink, textile, ceramic and ferro-alloy industries.

Studies of Clouds.—During the last two years systematic researches have been carried on at Poona by taking photographs of some types of natural clouds at short intervals of time. The various changes thus observed confirm a number of points brought out by experiments on artificial clouds. This forms the subject of a paper just published by the India Meteorological Department (*Scientific Notes*, Vol. VIII, No. 94) in which some of the selected series of photographs are reproduced.

The movement and appearance of clouds give us valuable information about the physical conditions of the atmospheric layers in which they are embedded. Apart from the routine observations, such as the measurement of height, velocity and direction, total amount, kind, etc., of clouds at the time of observation at a meteorological station, special studies are in progress at different places. In recent years, for example, artificial clouds have been produced in the laboratory and their movements under conditions resembling those in the atmosphere are watched and recorded carefully. The clouds thus produced greatly resemble in form and pattern, the natural clouds.

Census of Essential Drugs.—With a view to maintaining a check on the import, manufacture and sale of essential drugs, a new Order has been promulgated by the Central Government under the Defence of India Rules. The Order is called the Essential Drugs (Census) Order, 1941, and is to come into force at once.

In accordance with this Order, any person engaged in the business of manufacturing, importing or selling such drugs, whether wholesale or retail, is required to submit to the authority specified for his area, so as to reach that authority not later than the 27th day of each month, a return showing the quantity of any essential drug in his possession or under his control within British India on the 20th day of such month. No return, however, is required to be submitted if the total quantity of any essential drug in the possession or under the control of any person is less than that specified in the Order.

Every manufacturer, importer or dealer in drugs, whether wholesale or retail, is required to keep a record of the purchase or sale of any quantity of an essential drug made by him, whether such quantity is less than that specified or not. No record of such transactions, however, need be kept by a retailer if the total quantity of an essential drug in his possession or under his control is less than that specified.

The correctness of any return submitted or record kept in pursuance of this Order is subject to verification by any person authorised by the Central or the Provincial Government for this purpose. The person so authorised will have the right to enter and inspect the premises of any manufacturer, importer or dealer and to inspect and take copies of any records, books or accounts kept in connection with such business.

The following are the authorities specified for receiving the returns in the various areas:—
Madras, the Central Provinces and Berar, and Coorg—The Deputy Assistant Director General (Medical Stores), Madras.

Bombay Presidency, Sind and Ajmer-Merwara—The Deputy Assistant Director General (Medical Stores), Bombay.

Bengal Presidency, Bihar, Orissa and Assam—The Deputy Assistant Director General (Medical Stores), Calcutta.

United Provinces, the Punjab, North-West Frontier Province and Baluchistan—The Deputy Assistant Director General (Medical Stores), Lahore.

According to a Press Note from the Supply Department the first stage in making India self-sufficient in the manufacture of high explosives has been reached by the production of pure toluene for nitration at a newly erected toluene plant.

Another notable development is that basic steel manufactured by acid process from 100 per cent. scrap is now being made by an engineering works. It is anticipated that this will relieve the shortage of spring steel required by the Railways which had hitherto been imported.

Electric Grid Scheme for Orissa.—An electric "grid scheme" for the Province of Orissa is under investigation. The sources of power are hydro and thermal energy as hydro-electric power is available for South Orissa while for North Orissa cheap coal may be obtained.

Two possible hydro-electric sites are the Bogra Falls of the Kolab river, about 11 miles from Jeypore, and the Duduma Falls of the Machkand river, about 40 miles from Jeypore—both in the Koraput District. The Kolab River Scheme consists of a dam storing about 2,200 million cubit feet of water for a peak load of 72,000 K.W. and continuous load of 36,000 K.W. under a gross head of 611 feet.

The whole scheme would cost about Rs. 3,75,00,000 excluding transmission lines and substations. As, however, such an immense load will not be available within economic distance of the falls in the near future, a modified scheme, which will have a maximum installed capacity of 18,000 K.W., is under consideration.

From the Duduma Falls it is possible to obtain a drop of about 830 feet at a minimum continuous flow of nearly 150 cusecs and it appears from preliminary investigation that the civil engineering portion of this scheme may be slightly less than that of the Kolab Scheme.

The preliminary survey so far carried out shows that ample load will be available within

economic distance of transmission from the proposed sites and it appears that one more paper mill may be run economically in the district.

World Consumption of Jute.—The Indian Central Jute Committee has just issued an important brochure entitled "World Consumption of Jute, 1938-39 and 1939-40" (*Economic Research Bulletin No. 1*). This publication has brought together much valuable statistical material on jute trade and industry and gives various estimates that are not available elsewhere.

"Reliable estimates of the total consumption of jute in the world are given in this *Bulletin* for the period from 1933-34 to 1939-40. They show how this figure reached its peak in the year 1936-37, when an aggregate consumption of about 123 lakhs of bales was reached, and how in spite of the hectic buying at the beginning of the war, the total world consumption of jute in 1939-40 fell considerably short of this peak figure. Independent estimates of the yield of the jute crop are also given for the 1938-39 and 1939-40 seasons. The *Bulletin* also embodies the results of important investigations carried out by the Economic Research Sub-Section of the Committee in connection with the estimation of the world consumption of jute. These cover a number of important subjects, such as the trend of Indian jute mill production as compared with that of world industrial production, changes in the jute export trade, effect of war on the consumption of jute, etc.

"An interesting feature of the *Bulletin* is an attempt to give a general idea of the extent of jute consumption in the 1940-41 season on the basis of the demand for jute in the first few months of the season. The brochure concludes with a forecast that the consumption of jute in 1940-41 will be abnormally low."

Indian Central Cotton Committee.—The monsoon meeting of the Committee was held on the 18th and 19th July 1941, Mr. P. M. Kharegat, C.I.E., I.C.S., Vice-Chairman of the Imperial Council of Agricultural Research, presiding.

The progress reports of the several agricultural schemes financed by the Committee during the past year were reviewed and recommendations made regarding future lines of work. The extension of the Broach and Jalgaon Cotton Breeding Schemes, the Wilt Cotton Breeding Scheme, Poona, the Scheme for the improvement of Wagad cotton at Viramgam and Jagudan, the Cotton Genetics Research Scheme, Indore, and the Mysore (*Doddahathi*) Cotton Scheme were sanctioned.

Among the new schemes considered and approved were the scheme for the Improvement of Dharwar-American Cotton, two marketing survey schemes—one for the Madras Province and the other for Gujarat and the adjoining Agencies and States of Kathiawar and South Rajputana—and a Model Projects Scheme for the extension of improved methods of cultivation in the Rohilkhand and Kumaon Circle of the

United Provinces. The Committee also recommended the appointment of a co-ordinating Cotton Botanist for the Province of Bombay.

Among other questions that engaged the attention of the Committee, mention may be made of the following:—The establishment of an export organisation for extending the use of Indian cotton goods in other countries; alternative uses for short-staple cotton; and improvement of cotton forecasts. The annual report of the Technological Laboratory for the year ending May 31, 1941, was approved.

Medicinal Drugs and Chemicals.—The Bombay Government have arranged for the production of the following medicinal drugs and chemicals, under the guidance of their Industrial Research Chemist, to meet the large demands of the Supply Department: Phosphorus, tartaric acid, potassium perchlorate, iodine, strontium carbonate and carbon bisulphide.

Display of Indigenous Products.—According to a press note, issued from the Supply Department of the Government of India it has been decided to establish sample rooms at six Provincial centres with the Controllers of Supplies, Calcutta, Madras, Bombay, Karachi, Lahore and Cawnpore. It is proposed to establish a sample room at New Delhi as well.

In all these sample rooms it is proposed to display (1) such articles as are at present not produced in India but demand for which exists; (2) articles not being produced in sufficient quantities in India to meet the demands in full; (3) articles previously exclusively produced by ordnance factories at the various centres but which are now proposed to be transferred to trade production.

An Officer on Special Duty has been appointed to organise the establishment of the sample rooms and arrangements are being made for specified samples of articles required by the Defence Services to be provided.

Granite Rollers in Soap Making.—It is well known that toilet soap manufacturers use either granite rollers or steel rollers in the milling processes. On account of war and the consequent difficulties some of the users of the granite rollers have found it difficult to import the same from abroad.

Recently a big paint manufacturing firm in Calcutta who use granite rollers in their paint industry were faced with the same difficulty and they experimented with granite found in the State of Mysore. These have given complete satisfaction.

Information regarding these rollers may be had from Messrs. Narayanaswamy & Son, Lakshmipuram, Mysore.

ASTRONOMICAL NOTES

The Sun will be at the autumnal equinox on September 23, 1941, at 16^h 30^m I.S.T.

Eclipses.—Two eclipses will occur during the month:

(1) a partial eclipse of the Moon on September 5, 1941, the circumstances of which are as follows:—

Moon enters umbra	10 ^h 49 ^m p.m. I.S.T.
Middle of Eclipse	11 ^h 17 ^m " "
Moon leaves Umbra	11 ^h 45 ^m " "

The magnitude of the eclipse will be 0.06 (taking the Moon's diameter to be unity).

(2) a total eclipse of the Sun, which will be visible generally as a partial eclipse throughout India except in the extreme south. The path of totality commences near the Caspian Sea in Russia and passing through Turkestan, Central Asia and China ends in the middle of the Pacific Ocean.

	Madras	Bombay
Eclipse begins	8 ^h 16 ^m	7 ^h 50 ^m
Greatest phase	8 ^h 50 ^m	8 ^h 35 ^m
Eclipse ends	9 ^h 26 ^m	9 ^h 24 ^m
Magnitude of partial phase	0.08	0.23

Planets during September 1941.—Mercury is in the evening sky but will be too close to the Sun and cannot be seen well, except during the last few days of the month. Venus continues to be an evening star; it is increasing in brightness and will set about a couple of hours after the Sun. Mars will rise an hour after sunset and is steadily becoming brighter, its stellar magnitude being -2.3 at the end of the month; the planet is stationary on September 6 when it commences to move in a retrograde direction among the stars along the southern border of Pisces. Mars will be the most prominent object in the night sky during the month.

Jupiter will be in quadrature with the Sun on September 13; it rises about midnight and will be a conspicuous object (magnitude -2.0) in the eastern sky during the second half of the night. Saturn is stationary on September 11 when it begins to move westward among the stars in the constellation Taurus. The ring system continues to widen, the angular dimensions of the axes of the ring ellipse being 43".2 and 17".5. About three or four degrees to the north-east of Saturn is Uranus which reaches a stationary point on September 5, and starts moving in a retrograde direction a little to the south-east of the well-known star cluster Pleiades. Among occultations of some interest that can be observed in this country may be mentioned that of the star ρ Sagittari (mag. 4.0) on September 1, and that of the first magnitude star Aldebaran (α Tauri) at about midnight on September 12.

T. P. B.

SEISMOLOGICAL NOTES

During the month of July 1941 seven slight earthquake shocks were recorded by the Colaba seismographs as against one slight and three moderate ones recorded during the same month in 1940. Details for July 1941 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
July 1941—		H.	M.	(Miles)		(Miles)	
2	Slight	08	12	1450			
9	Slight	06	09	1550			
14	Slight	07	32	1450	11°·7 N., 93°·0 E., near the Andaman Islands		Apparently the after shocks of the very large earthquake of June 26, 1941
18	Slight	05	01	1500			
22	Slight	01	49	1450			
24	Slight	19	23	3550			
27	Slight	01	42	4700			

ANNOUNCEMENTS

Register of Chemists.—An All-India Register of Chemists is being prepared by the Indian Chemical Society. All chemists employed or unemployed are requested to have their names enrolled in the Register of Chemists in the prescribed form. Such a register will be of immense service and value to all interested in the chemical profession and trade, and also in the employment of chemists as a source of ready reference. The unemployed chemists will find it useful to register their names as the Society intends to put them in touch with employers whenever occasion arises. No fees are demanded for registration. Necessary forms will be sent on application to P. K. Bose, Hony. Secretary, Indian Chemical Society, P.O. Box No. 10857, Calcutta.

The next meeting of the Inter-University Board, India, will be held at Chidambaram on January 6-7, 1942.

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 89, Nos. 4586-87.

"Agricultural Gazette of New South Wales," Vol. 52, Pts. 5-6.

"Indian Journal of Agricultural Science," Vol. 11, Part 3.

"Indian Forester," Vol. 67, Nos. 7-8.

"Indian Farming," Vol. 2, No. 7.

"Indian Medical Gazette," Vol. 76, No. 7.
"Journal of the Indian Botanical Society," Vol. 20, No. 4.

"Journal of the Indian Chemical Society," Vol. 18, No. 4.

"Nature," Vol. 147, Nos. 3731-33.

"The Philippine Journal of Science," Vol. 74, Nos. 1-3.

"The Indian Journal of Physics," Vol. 24, Part 1.

"Proceedings of the Royal Society of Edinburgh," Vol. 60, Part 4.

"Canadian Journal of Research," Vol. 19, No. 4.

"Sky," Vol. 5, No. 8.

"Science and Culture," Vol. 7, No. 2.

"Ceylon Journal of Science," Vol. 3, Part 2.

"The Indian Trade Journal," Vol. 142, Nos. 1829-33.

BOOKS

"Sons of the Soil," edited by W. Burns. (Manager of Publications, Delhi), 1941. Pp. 128 + 44 plates. Price Rs. 2-6 or 4sh.

"Anthropological Papers." (Calcutta University), 1941. Pp. 187.

"The Scientific Photographer," by A. S. C. Lawrence. (Cambridge University Press), 1941. Pp. x + 180. Price 18sh.

"Reports on Progress in Physics," Vol. VII, edited by J. H. Awbery. (The Physical Society, London), 1941. Pp. 1 + 362. Price 22sh. 6d.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:
(Proceedings)

July 1941, SECTION A.—P. G. N. NAYAR: The luminescence, absorption and scattering of light in diamonds. Part III. Absorption. The features of the absorption in diamond observed by the author and earlier workers are shown to be inconsistent with the electronic energy levels obtained from the theoretical calculations of Kimball. Thus crystals do not actually conform to the ideal lattice, and a certain secondary structure brings about new intermediate levels. KANTILAL C. PANDYA AND P. GEORGE VARGHESE: The condensation of aldehydes with amides. Part VII. The condensation of Piperonal. KANTILAL C. PANDYA AND P. GEORGE VARGHESE: The condensation of aldehydes with amides. Part VIII. The condensations of 6-Nitropiperinal. P. SURYAPRAKASA RAO AND T. R. SESHADRI: Constitution of Butrin. P. SURYAPRAKASA RAO: A note on the methylation of quercetagenin. B. R. SETH: On Guest's law of elastic failure. B. LAKSHMAN RAO: Raman effect in potassium tartrate crystal. G. V. L. N. MURTHY: Colour analysis and colorimetry. Part I. Nitrate estimation. B. LAKSHMAN RAO: Raman spectra of some crystalline nitrates and sulphates. The sulphates examined in the form of single crystals have yielded all the frequency shifts characteristic of the internal oscillations of the sulphate ion, including some of the split components of the degenerate lines and also some new lattice frequencies. P. RAMA PISHAROTY: On the geometry of the quantum reflection of X-rays in diamond. The appearance of quantum reflections outside the plane of incidence in cases when it is not a plane of symmetry is worked out quantitatively and the agreement with observation is a striking evidence of the definite orientation of the phase waves associated with the lattice vibrations in this case. The streamers and the two subsidiary spots accompanying the modified reflection (Raman and Nilakantan), their behaviour with changes of crystal setting, the tripling of the spots in a particular setting (Jahn and Lansdale), the changes with changes in angle of incidence—all these different phenomena are shown to be geometrical consequences of a postulate of three sets of phase waves. M. W. CHIPLONKAR: The brightness of the zenith sky during twilight. BRAJ KISHORE MALAVYA AND SIKHIBHUSHAN DUTT: Chemical examination of the fixed oil derived from the seeds of *Lallemantia royleana* Benth. or *Tukhm-i-malanga*. N. ANANTHANARAYANAN: Spectroscopic examination of the diffraction of light by a thin metallic half-plane.

SECTION B.—S. B. KAUSIK: Structure and development of the staminate flower and the male gametophyte of *Enalus acoroides* (L.f.), Steud. G. N. RANGASWAMI AYYANGAR AND B. W. X. PONNAIYA: Studies on *Para-Sorghum* Snowden—the group with bearded nodes. S.

RAMANUJAM: A haploid plant in *Toria* (*Brassica campestris* L.). T. S. RAGHAVAN AND A. R. SRINIVASAN: Cytogenetical studies in *Nicotiana*. Part II. Morphological features of *Nicotiana glutinosa* and the Hybrid between *Nicotiana glutinosa* and *N. tabacum*. JAI CHAND LUTHRA AND INDER SINGH CHIMA: Some studies on the potentiality of shrivelled wheat grains. I. FROILANO DE MELLO: First record of an *Amæba* parasite of an Indian Termite.

Indian Chemical Society:
(Journal)

April 1941.—J. C. GHOSH, S. K. BHATTACHARYA, M. M. DUTT AND M. J. RAO: Iodination. Part I. Studies on the equilibrium in systems of iodine and various unsaturated organic compounds in the dark in different non-polar solvents. DUSHYANT NARASINGASA SOLANKI AND BHASKAR GOVIND JOSHI: Electrodeposition of cadmium on Iron. P. V. KRISHNAMURTHY AND K. V. GIRI: Studies in Vitamin-C oxidation. Part II. Influence of various substances occurring in plant and animal tissues on the catalytic oxidation of Vitamin-C. NRIPENDRA NATH CHATTERJEE AND AMALENDU BOSE: A new synthesis of eudalene. P. V. KRISHNAMURTHY: Studies in Vitamin-C oxidation. Part III. The retardation of Vitamin-C oxidation by oxalic acid. K. N. GAIND, R. P. SEHGAL AND J. N. RAY: Sulphonamides. Part II. K. N. GAIND, (MISS) S. KAPOOR AND J. N. RAY: New method of synthesis of isoQuinoline derivatives. PRIYADARANJAN RAY AND BHUPESH CHANDRA PURAKAYASTHA: Complex compounds of biguanide with bivalent metals. Part III. Nickel biguanidines. RAMACHANDRA SAHASRABUDHEY AND HANS KARALL: The phenylthiocarbamides. A contribution to the study of the triad-N.C.S. Part X. Action of hydrolytic agents, alkaline lead acetate and nitrous acid on thiosemicarbazide. T. V. SUBBA RAO AND G. GOPALARAO: Decomposition of potassium nitrate in sunlight. PHNINDRA CHANDRA DUTTA: A new synthesis of cadalene.

Indian Botanical Society:
(Journal)

July 1941.—GIRIJA P. MAJUMDAR: The sliding, gliding, sympatric or the intrusive growth of the Cambium cells and their derivatives in higher vascular plants. SULTAN AHMAD: *Gasteromycetes* of the Western Himalayas—I. R. K. SAKSENA: Importance of growth-promoting substances in the metabolism of *Pythium indigoferæ* Butler. V. NARAYANASWAMI: A new *Gymnosporia* from Bastar State, India—*Gymnosporia Bailadillana Narayanaswami* et Mooney spec. nov. (*Celastraceæ-Celastræ*). F. R. BHARUCHA AND MISS D. B. FERREIRA: The biological spectra of the Matheran and Mahabaleshwar flora. GHAS-UD-DIN AHMAD: Effect of light intensity and temperature on the growth of *Azolla filiculoides*.

